

SPORT FISHERY ABSTRACTS

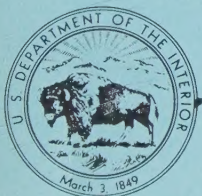
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SPORT FISHERY ABSTRACTS

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18087. Evans, Dale R., and Stanley D. Rice (Nat'l. Mar. Fish. Serv., NOAA, Juneau, Alaska 99801). 1974. EFFECTS OF OIL ON MARINE ECOSYSTEMS: A REVIEW FOR ADMINISTRATORS AND POLICY MAKERS. NOAA Fish. Bull., 72(3): 625-638.

A broad selection of recent literature on the effects of oil on marine ecosystems is reviewed. The focus is on studies on crude oil, and the results are discussed with the purpose of providing a summary of findings that will be a useful reference for administrators and policy makers involved in decisions concerning petroleum developments and related activities. The characteristics of crude oil and factors modifying its impact on the marine environment are discussed. Most research on the toxicity of oil has dealt with acute effects and data on long-term impacts at the community level are inconclusive. It is concluded that chronic low-level pollution is potentially more damaging to ecosystems than isolated catastrophic spills. Decision makers are forced to rely on interpretative judgments rather than conclusive data. (Authors)

18088. Kaiser, Klaus L. E. (Environ. Canada, Canada Centre for Inland Waters, Burlington, Ontario, Canada). 1974. MIREX: AN UNRECOGNIZED CONTAMINANT OF FISHES FROM LAKE ONTARIO. Science, 185(4150): 523-525.

A perchlorinated, cage-structured hydrocarbon, $C_{10}Cl_{12}$, also known as mirex or Dechlorane, has been identified in fish samples from the Bay of Quinte, Lake Ontario, Canada. The compound coelutes with polychlorinated biphenyls (PCB's) in residue cleanup procedures and under standard gas chromatographic conditions. Mirex has never been registered for use as an insecticide in Canada, nor does it appear to be in use in any area of the United States discharging water into Lake Ontario or its tributaries. It seems likely, therefore, that this compound is another widespread environmental contaminant of extremely high geochemical stability and as yet only superficially investigated biological activities. Under standard gas chromatographic conditions its peak is superimposed on that of the PCB's, and, as a result, the presence of mirex may have been unrecognized and it may therefore have been misinterpreted as a PCB isomer. (Auth.)

18089. D'Aoust, Brian G., and Lynwood S. Smith (Virginia Mason Res. Center, and Univ. of Washington, Seattle, Wash. 98101). 1974. BENDS IN FISH. Comp. Biochem. Physiol., 49(2A): 311-321.

Fish mortality due to low-level nitrogen supersaturation in natural waters (as little as 15 percent) raises the question of their sensitivity to decompression-induced diver's bends. Fingerling salmonids (Salmo gairdnerii and Oncorhynchus kisutch) have been saturated with air, and normoxic helium and argon at a range of initial pressures (P_i), up to 6 atm, and then decompressed through a range of initial/final pressure (P_f) ratios (P_i/P_f) as high as 8.0. The results clearly show marked differences in bends-producing potential of these different gases with formation of histologically demonstrated tissue bubbles and emphasize the unsuitability of either excess partial pressure (ΔP) or relative decompression (P_i/P_f) as predictive indices of decompression stress. The results indicate that experimental determination of the critical conditions for bubble formation in blood and tissues *in vivo* may be possible with such material to a precision not possible in mammalian studies. (Authors)

18090. Hines, Ron S., and Dan T. Spira (Agric. Res. Organization, Fish and Aquaculture Sta., Dor, Israel). 1974. ICHTHYOPHTHIRIASIS IN THE MIRROR CARP Cyprinus carpio (L.). IV. PHYSIOLOGICAL DYSFUNCTION. J. Fish Biol., 6(4): 365-371.

Changes in blood ion concentration, oxygen absorption, blood haemoglobin concentration and blood urea-ammonia nitrogen level were measured in a group of mirror carp, Cyprinus carpio (L.) infected with measured numbers of Ichthyophthirius multifiliis under standardized conditions. The disease was characterized by a drop in serum sodium and magnesium and increase in serum potassium. The ability of infected fish to absorb oxygen was reduced as was their ability to tolerate dissolved oxygen concentrations under 5 ppm. Blood urea-ammonia level was elevated during the disease but blood haemoglobin level remained unchanged. (Authors)

18091. Schubel, J. R. (The Johns Hopkins Univ., Baltimore, Maryland 21218). 1974. EFFECTS OF EXPOSURE TO TIME-EXCESS TEMPERATURE HISTORIES TYPICALLY EXPERIENCED AT POWER PLANTS ON THE HATCHING SUCCESS OF FISH EGGS. *Estuarine and Coastal Marine Science*, 2(2): 105-116.

Blueback herring, alewife, American shad, white perch and striped bass eggs were subjected to time-temperature histories typically experienced by organisms that are either carried through the once-through cooling system of a power plant, or are entrained into the thermal plume without passing through the plant. The maximum excess temperature tested ranged from 6-10°C and the time of exposure to a maximum T from 2.5-60 min. The period of cooling to the final temperature ranged from 60-300 min. For each species, six to eight experiments were run on six to twelve sub-samples of 200-400 eggs from a single female. Several different stages of development were tested. Analyses of variance showed that for each species the differences in hatching success among the various time-temperature treatments, including the control treatment, were not significant at the 1% level. Further, for each species the mean hatching success of the controls did not differ significantly from the mean hatching successes associated with any of the experimental time-temperature treatments. The investigator concludes that exposure of fish eggs of the species and development stages tested to these time-temperature histories does not significantly affect their hatching success. (Auth.)

18092. Hocutt, Charles H., Roger L. Kaesler, Michael T. Masnik, and John Cairns, Jr. (Virginia Polytech. Inst. and State Univ., Blacksburg, Virginia 24061). 1974. BIOLOGICAL ASSESSMENT OF WATER QUALITY IN A LARGE RIVER SYSTEM: AN EVALUATION OF A METHOD FOR FISHES. Reprint; The ASB Bulletin, 21(2): p. 62.

Fish have some disadvantages as indicators of stress conditions in aquatic systems. They are mobile and can migrate to and from stressed areas at will if not so drastically affected that movement is curtailed. Furthermore, data gathering may be highly qualitative and not easily interpreted. The public, however, more often focuses its attention on fish than other aquatic organisms and is not fully satisfied about the health of an aquatic system unless fish information is available. This study provides data on fish collected during the summers 1971 and 1972 from the New River in the vicinity of the Celanese Fibers Company, Pearlsburg, Virginia. These data were analyzed by two methods and contrasted: the diversity index (d) of Wilhm and Dorris (1968, *Bio-Science* 18: 472-481) and the Jaccard (1908, *Soc. Vaud. Sci. Nat.* 44: 223-270) similarity coefficient (S_j). The former is a method currently used in monitoring aquatic ecosystems and is a function of the numbers and kinds of species found. The latter analyzes only presence or absence data at each station. S_j was easily adapted to monitoring, provided a more critical method of analyzing data, especially where data were redundant, and is recommended as a method for the biological assessment of water quality. (Authors)

18093. Wrigley, Robert C., and Alexander J. Horne (Space Sci. Div., NASA, Ames Res. Centre, Moffett Field, California 94035). 1974. REMOTE SENSING AND LAKE EUTROPHICATION. *Nature*, 250(5463): 213-214.

An infrared photograph of part of Clear Lake, California shows beautiful, complex patterns of blue-green algal blooms which were not observed by conventional limnological techniques. Repeated observations of patterns such as these can be used to chart the surface movement of these buoyant algae and can also be used to help control algal scums in eutrophic lakes. (From text)

18094. Dechtiar, Alex O. (Fish & Wildl. Res. Br., Ontario Min. of Nat. Res., Maple, Ont., Canada). 1974. Dactylogyrus buddi n. sp. (MONOGENOIDEA: DACTYLOGYRIDAE) FROM THE GILLS OF THE SCULPINS OF LAKE HURON. *Can. J. Zool.*, 52(7): 861-863.

A new species of monogenean, Dactylogyrus buddi from the gills of the sculpins Cottus bairdi Girard (type host) and C. cognatus Richardson (other host) is described. This is the first report of a monogenean of the genus Dactylogyrus from North American cottid fishes and the second from the world. (Auth.)

18095. Coleman, Ronald L., and Jack E. Cearley (Dept. of Environ. Health, Univ. of Oklahoma Health Sci. Center, Oklahoma City, Okla. 73190). 1974. SILVER TOXICITY AND ACCUMULATION IN LARGEMOUTH BASS AND BLUEGILL. *Bull. Environ. Contam. Toxicol.*, 12(1): 53-61.

Exposure of juvenile largemouth bass and bluegill to silver (0.3 to 70 µg/liter) resulted in accumulation of this metal. The quantity of metal accumulated increased as exposure concentration increased with a subsequent equilibrium developing between the water and tissue concentrations. Metal accumulations in the bass tissues were highest in the internal organs, followed by the gills and remainder of the body. The greatest increase was exhibited in the gills. Zinc concentrations in the bass body remainder and the bluegill total body appeared to vary in an approximately inverse relationship to the initial accumulation of silver within the tissues. The bass were more sensitive to silver than the bluegill. Abnormal behavior patterns were observed in both species. (Authors' summ.)

18096. McCain, B. B., J. L. Fryer, and K. S. Pilcher (Dept. of Microbiology, Oregon State Univ., Corvallis, Oregon 97331). 1974. PHYSICOCHEMICAL PROPERTIES OF RNA OF SALMONID HEMATOPOIETIC NECROSIS VIRUS (OREGON STRAIN) (38161). *Proc. Soc. Exp. Biol. Med.*, No. 146, pp. 630-634.

Infectious hematopoietic necrosis virus (IHNV) (Oregon strain) was propagated in salmonid cell lines and purified by differential and density gradient centrifugation. The virus had a density in sucrose gradients of 1.16 g/cm³. The nucleic acid extracted from purified virus was shown to be RNA as determined by chemical analysis, by its density in a cesium sulfate gradient, and by its sensitivity to ribonuclease. The latter property, together with a nonequimolar ratio of adenylic to uridylic acids, indicate its single stranded nature. (Authors' summ.)

18097. Sanders, Herman O. (U. S. Fish & Wildl. Serv., Fish-Pesticide Research Lab., Columbia, Missouri 65201). 1972. TOXICITY OF SOME INSECTICIDES TO FOUR SPECIES OF MALACOSTRACAN CRUSTACEANS. *Tech. Papers of the Bureau of Sport Fisheries and Wildlife* No. 66, pp. 3-19.

Acute and long-term (20-day) toxicities of 40 insecticides to four species of freshwater malacostracan crustaceans -- the scud *Gammarus fasciatus*, the crayfish *Orconectes nais*, the glass shrimp *Palaemonetes kadiakensis*, and the aquatic sowbug *Asellus breviceaudus* -- were determined in static and intermittent-flow bioassays. An extremely wide range in toxicity was found with 96-hour TL₅₀ (median tolerance limit) values ranging from 0.10 to 100,000 micrograms per liter. Scuds were generally the most sensitive, followed in descending order by glass shrimp, sowbugs, and crayfish. Azinphosmethyl and coumaphos were the most toxic and malathion the least toxic to three of the four species. Early instar crayfish (0.03-0.05 gram) were consistently more susceptible to insecticides than later instar crayfish (7-11 grams). The TL₅₀ values for 5-day exposures to some insecticides were similar in static and in intermittent-flow bioassays. A progressive reduction in TL₅₀ values occurred when animals were exposed continuously to insecticides for 20 days. (Auth.)

18098. Spinelli, John, Lawrence Lehman, and Dave Wieg (U.S. Dept. of Comm., NOAA, NMFS, Pacific Fishery Products Technology Center, Seattle, Washington 98112). 1974. COMPOSITION, PROCESSING, AND UTILIZATION OF RED CRAB (*Pleuroncodes planipes*) AS AN AQUACULTURAL FEED INGREDIENT. *J. Fish. Res. Board Can.*, 31(6): 1025-1029.

The proximate composition, amino acid profile, and fatty acid composition of red crab (*Pleuroncodes planipes*) indicated that it was highly suitable for inclusion in salmonid diets. The amino acid profile of the proteins was similar to those of fish and the fatty acid composition was approximately 40% linolenic. Rainbow trout fed Oregon Moist Pellet (OMP) type diets containing 10 and 25% red crab were highly pigmented after 2 mo. A method for processing red crab into a dry feed material and a chitinous residue suitable for further processing into chitin derivatives was described. (Authors)

18099. Hines, Ron S., and Dan T. Spira (Agric. Res. Organization, Fish and Aquaculture Sta., Dor, Israel). 1974. ICHTHYOPHTHIRIASIS IN THE MIRROR CARP Cyprinus carpio (L.). V. ACQUIRED IMMUNITY. J. Fish Biol., 6(4): 373-378.

Mirror carp (Cyprinus carpio L.) infected with sublethal doses of Ichthyophthirius multifiliis, were free of parasites 21 days after infection. Fish remained free of parasites for at least 8 months when maintained in an infective environment. Such fish were refractory to re-infection with numbers of parasites that killed all normal, previously unexposed fish. Serum from fish recovered from previous infections with sublethal doses of parasites, immobilized free-swimming stages of I. multifiliis to a dilution of up to 1 : 1024. The rise in serum-immobilization titre occurred between the 10th and 22nd days of infection, the period during which parasites disappeared from the body surface of the fish. Infective stages of the parasite were unable to penetrate the mucus body covering of resistant fish. (Authors)

18100. Elson, Paul F. (Dept. of the Environ., Fish. and Mar. Serv., Biol. Sta., St. Andrews, New Brunswick, Canada). 1974. IMPACT OF RECENT ECONOMIC GROWTH AND INDUSTRIAL DEVELOPMENT ON THE ECOLOGY OF NORTHWEST MIRAMICHI ATLANTIC SALMON (Salmo salar). J. Fish. Res. Board Can., 31(5): 521-544.

The history of Atlantic salmon (Salmo salar) runs of the Northwest Miramichi from 1950 to 1973 is reviewed. Decreases in these runs are related to degrading of ecological conditions in the river's rearing reaches as a result of adverse chemical conditions attributable to recent developments in forest management and to base metal mining. Diversion of indigenous adult stocks into other streams of the system as a result of pollution of the home stream by mining, pulpmill, and other human activities is examined and evaluated. Increase of commercial catches as a result of pollution-caused delay in the estuary of migrating adults is analyzed. Grave depletion of stocks as a result of the combined effects of these factors plus distant-water fishing is identified, as is incipient recovery of stocks when home-water commercial fishing was eliminated and pollution abatement measures were introduced to the river. A suppressing effect of heavy angling pressure on stock abundance when stocks are low is noted. (Auth.)

18101. Seidel, Wilber R., and Edward F. Klima (Southeast Fish. Center, NMFS, NOAA, P. O. Drawer 1207, Pascagoula, Mississippi 39567). 1974. IN SITU EXPERIMENTS WITH COASTAL PELAGIC FISHES TO ESTABLISH DESIGN CRITERIA FOR ELECTRIC FISH HARVESTING SYSTEMS. NOAA Fish. Bull., 72(3): 657-669.

In situ experiments to test the efficacy of a scale electrical harvesting system were conducted off Panama City, Fla. with both captured and wild coastal pelagic fishes. Six species of fish were exposed to preselected combinations of pulse rate, pulse width, and voltage by either attracting wild fish or placing captured fish between electrodes. Both captured and wild fish could be effectively controlled with a minimum field strength of 15 V/m, 20 to 35 pulses/s, and a pulse width of more than 0.5 ms. Voltage, pulse width, and pulse rate were equally important for controlling the species tested. Based on these results, resistance measurements were calculated and a potential netless harvesting system specified which would require a minimum energy output of 120 kVA dissipated into an electrode configuration 10 x 5 x 5 m with a load resistance of 0.01558 ohms. The basic design specifications for a prototype pulse generator are provided for netless fish harvesting applications and mid-water trawling. (Authors)

18102. Roubal, William T., Howard M. Etlinger, and Harold O. Hodgins (Northwest Fish. Center, NMFS, NOAA, Environ. Conserv. Div., 2725 Montlake Blvd. East, Seattle, Washington 98112). 1974. SPIN-LABEL STUDIES OF A HAPTEN-COMBINING SITE OF RAINBOW TROUT ANTIBODY. J. Immunol., 113(1): 309-315.

The hapten-combining site for trout anti-DNP antibody has been compared with that of rabbit by using spin-labeled haptens and electron paramagnetic resonance spectroscopy. The average depth of the combining sites in both trout and rabbit was calculated to be 11.5 Å. (Authors)

18103. Trojnar, John R., and Robert J. Behnke (Colo. Coop. Fish. Unit., Colo. State Univ., Fort Collins, Colorado 80521). 1974. MANAGEMENT IMPLICATIONS OF ECOLOGICAL SEGREGATION BETWEEN TWO INTRODUCED POPULATIONS OF CUTTHROAT TROUT IN A SMALL COLORADO LAKE. Trans. Amer. Fish. Soc., 103(3): 423-430.

Ecological differences reflected in food and habitat preference and angling vulnerability were investigated between two introduced sympatric populations of cutthroat trout, Salmo clarki. The Pikes Peak cutthroat fed to a large extent on Daphnia (68% by volume), whereas the Snake River cutthroat fed primarily on terrestrial insects (68% by volume). Other food habit differences were observed in the brook trout, Salvelinus fontinalis, and rainbow trout, Salmo gairdneri, populations. The Snake River cutthroat trout was more vulnerable to angling than the Pikes Peak cutthroat. This was due in part to the opportunistic and surface feeding behavior of the Snake River cutthroat and angling restrictions which resulted in most fishermen angling on or near the surface. The Pikes Peak cutthroat had a high mortality rate during August and September. This coincided with the period of greatest competition with the longnose sucker, Catostomus catostomus, for Daphnia. The results illustrate the practical application of intraspecific variability in fisheries management programs. The establishment of interacting populations of the same or different species can result in more efficient use of the food resources of a lake and greater fish production. It is urged that every effort be made to preserve the remaining genetic diversity in polytypic species such as S. clarki. (Authors)

18104. Giger, R. D. (Oregon State Game Comm., Corvallis, Oregon 97331). 1972. SOME ESTUARINE FACTORS INFLUENCING ASCENT OF ANADROMOUS CUTTHROAT TROUT IN OREGON. In: Proc. 2nd Annual Tech. Conf. on Estuaries of the Pacific Northwest, Mar. 16-17, 1972; Oregon State Univ. Engineering Experiment Sta. Circular No. 44, pp. 18-29, 1972; Selected Water Resources Abstracts, 7(14): p. 27, 1974.

Study of coastal cutthroat trout, Salmo clarki clarki, on the north-central Oregon coast was directed primarily toward improvement of angler catches of hatchery-reared cutthroat through the manipulation of liberation times. To determine the timing and location of the estuary catch, information on fish distribution and movement was gathered and related to gross measurements of estuary geometry, salinity, and temperature. Results of estuary studies centering on the Alsea River are reported. Approximately 2000 sea-run cutthroat were captured and marked. More than 300 tags from these fish were subsequently returned providing information on timing of migration, estuary movements, length of estuary residence, and distribution and intensity of sport catch. Angler catch sampling gave additional information on food habits and fish movements. High temperatures in upper estuary areas of some coastal rivers prevent passage of fish that might otherwise migrate further upstream; as a result, ascending fish congregate in estuary areas of suitable temperature and depth immediately downstream until water temperatures moderate in the fall, thus the extended period of summer residence is advantageous to the estuary sport fisheries. Alteration of temperature regimes, depths, or perhaps other features could change fish distributional patterns and ultimately affect the success of fisheries.

18105. Wagner, Harry H. (Div. of Wildl. Res., Oregon Wildl. Comm., Corvallis, Oregon 97331). 1974. SEAWATER ADAPTATION INDEPENDENT OF PHOTOPERIOD IN STEELHEAD TROUT (Salmo gairdneri). Can. J. Zool., 52(7): 805-812.

As evidenced by immediate transition experiments, seawater adaptation in juvenile steelhead trout was independent of photoperiod and the onset of parr-smolt transformation. Increased survival occurred as the fish grew larger, and euryhalinity was reached at 12 to 13 cm. There was no marked regression in the hypoosmoregulatory mechanism in the summer. The regression reported in earlier studies was discussed in terms of seasonal changes in lipid reserves and Na^+ - and K^+ -activated adenosine triphosphatase (ATPase) activity in gill microsomes. (Auth.)

18106. Walters, Lester J., Jr., Thomas L. Kovacik, and Charles E. Herdendorf (Dept. of Geology, Bowling Green State Univ., Bowling Green, Ohio 43403). 1974. MERCURY OCCURRENCE IN SEDIMENT CORES FROM WESTERN LAKE ERIE. Ohio J. Sci., 74(1): 1-19.

The Detroit River is the major source of mercury contamination in the sediments of western Lake Erie. Analyses of 63 sediment cores indicate that the mercury consists of two components: a high-concentration (0.5 to 4.0 ppm of dry sediment) mercury-enriched surface zone, whose concentration decreases pseudo-exponentially with depth, and a low-concentration (0.04 to 0.09 ppm of dry sediment) relatively constant-background zone. Mathematical modeling of the mercury concentration as a function of depth in these sediment cores and subsequent statistical analysis of the apparent constant-concentration levels reveals that two log-normal distributions are necessary to describe these observed constant concentrations. Any mercury concentration within the sediment in excess of the lower (natural) background level plus one standard deviation is defined as being due to pollution. Such calculations of the pollution component for these 63 cores serve as the basis for an estimate of the total mercury that has been added through pollution sources. The mercury-pollution load for bottom sediments of western Lake Erie is estimated to be 228 metric tons. (Authors)

18107. Dunst, Russell C., Stephen M. Born, Paul D. Uttormark, Stephen A. Smith, Stanley A. Nichols, James O. Peterson, Douglas R. Knauer, Steven L. Serns, Donald R. Winter, and Thomas L. Wirth. 1974. SURVEY OF LAKE REHABILITATION TECHNIQUES AND EXPERIENCES. Dept. of Natural Resources, Madison, Wisconsin, Technical Bulletin No. 75, 179 p.

Excessive eutrophication of lakes is a serious international problem. There has been a great need for a comprehensive information source usable in developing future rehabilitation/protection programs. This state-of-the-art review represents an attempt to delineate the accomplishments of lake restoration-related activities worldwide. Information was acquired through an extensive mail survey (about 8,000 entries), cooperation of several international journals/newsletters, and a systematic literature search including foreign as well as domestic materials. The contents of this report consist of five major divisions: 1) identification, description and present utility of the various techniques, 2) compilation and description of individual past and/or ongoing restoration experiences (almost 600 accounts), 3) project methodology, 4) name and address of people providing pertinent information (over 300 respondents), and 5) literature references (more than 800 documents). (Authors)

18108. Kerekes, Joseph J. (Dept. of the Environ., Can. Wildl. Serv., c/o Biol. Dept., Dalhousie Univ., Halifax, Nova Scotia, Canada). 1974. LIMNOLOGICAL CONDITIONS IN FIVE SMALL OLIGOTROPHIC LAKES IN TERRA NOVA NATIONAL PARK, NEWFOUNDLAND. J. Fish. Res. Board Can., 31(5): 555-583.

Five oligotrophic lakes in Terra Nova National Park, Newfoundland, varying in mean depth (1.06-9.22 m), in water renewal rate (0.2-20.7 times per annum), in salinity (18.2-42.6 mg/liter), in total phosphorus (0.1-0.6 mg-at P/m³), and in chlorophyll a concentration (0.5-3.2 mg/m³), were investigated for 17 mo in 1969 and 1970. Hypolimnetic oxygen deficits ranged between 111 and 217 mg O₂ per m²/day. Low levels of nutrients, reduced solar radiation, and low underwater light penetration, owing to excessive cloudiness and high water color, seriously limited planktonic primary production. The relation between primary production at optimum light, and water renewal per annum, appeared to be curvilinear when the rate of primary production began to decline above an optimum water renewal rate. The seasonal and annual variations in water color and salinity were dependent on the rate of water renewal, but other lakes on the catchment areas modified that relation. Winter road salting operations within the catchment area caused a considerable increase in salinity, total phosphorus concentration, and primary production in one lake. A new morphometric index which reflects the littoral effect on basin volume was proposed. (Auth.)

18109. Hanson, David L., and Thomas F. Waters (Dept. of Entomol., Fish., and Wildl., Univ. of Minnesota, St. Paul, Minnesota 55108). 1974. RECOVERY OF STANDING CROP AND PRODUCTION RATE OF A BROOK TROUT POPULATION IN A FLOOD-DAMAGED STREAM. Trans. Amer. Fish. Soc., 103(3): 431-439.

The brook trout (Salvelinus fontinalis Mitchell) population in Valley Creek, Minnesota, recovered from heavy flood damage in 1965-66 in terms of standing crop, growth, and production rates over a period of 4 to 5 years. Standing crops of brook trout increased numerically by 20-fold from a low of 498/ha in 1966 to 10,882/ha in 1969, and in biomass by 6-fold from 25 kg/ha in 1966 to a maximum of 148 kg/ha in 1970. Growth rate early in the recovery period was high due to the low density of trout but decreased in successive years as fish density increased. Annual production was about 50 kg/ha during the flood years but increased during the recovery years to a maximum of 167 kg/ha in 1969. Cohort production for the 1965 year class, the one most seriously affected by the floods, was about 15 kg/ha, whereas cohort production for the 1968 year class, the last one that could be completely followed in this study, was about 190 kg/ha. After the floods, rainbow trout (Salmo gairdneri Richardson) immigrated into the study section from downstream; although variable in year class strength, the rainbow contributed substantially to total salmonid standing crop and annual production in some years. It has apparently become permanently established, even after total recovery of the brook trout population. (Authors)

18110. Trautman, Milton B., and Donald K. Gartman (The Ohio State Univ., Columbus, Ohio 43210). 1974. RE-EVALUATION OF THE EFFECTS OF MAN-MADE MODIFICATIONS ON GORDON CREEK BETWEEN 1887 AND 1973 AND ESPECIALLY AS REGARDS ITS FISH FAUNA. Ohio J. Sci., 74(3): 162-173.

Gordon Creek, a tributary of the Maumee River in northwestern Ohio, was investigated by Meek in 1887, by Trautman 1929-38, by the personnel of the Ohio Division of Wildlife between 1954 and 1973, and by Trautman and Gartman in 1973. Dredging and ditching in this area were begun about 1850, continuing until the present, with major channelization occurring in 1935. Channelization, together with the effects of dams and pollution, has had a major effect on the fish species present in this stream. The Central Mudminnow (Umbra limi), Grass Pickerel (Esox americanus vermiculatus), Goldenshiner (Notemigonus crysoleucas), Hornyhead Chub (Nocomis biguttatus), Mimic Shiner (Notropis volucellus), Tadpole Madtom (Noturus gyrinus), and Piraterperch (Aphredoderus sayanus) all require clean static or flowing water, rooted aquatic vegetation, sand and gravel substrates, and/or well-defined riffles and pools. These species have been largely reduced in population abundance or have been extirpated in part or entirely by the destruction of their habitats by channelization. In contrast, the Creek Chub (Semotilus atromaculatus), Common Shiner (Notropis cornutus), and Spotfin Shiner (Notropis spilopterus) are tolerant of a more or less uniform current flow, such as produced by channelization, and are therefore rather generally distributed and remain numerous. The Silverjaw Minnow (Ericymba buccata) and Johnny Darter (Etheostoma nigrum) were recorded in greatest numbers over gravel-sand substrates. The Carp (Cyprinus carpio), Fathead Minnow (Pimephales promelas), Bluntnose Minnow (Pimephales notatus), Common Sucker (Catostomus commersoni), Yellow Bullhead (Ictalurus natalis), and Green Sunfish (Lepomis cyanellus) occurred most numerous in undredged pools or in pools largely recovered from former ditching; these pools were with or without currents, undercut banks, fallen timbers and brush heaps, and had various types of substrates. The Largemouth Blackbass (Micropterus salmoides), Bluegill (Lepomis macrochirus), Suckermouth Minnow (Phenacobius mirabilis), and Orangespotted Sunfish (Lepomis humilis), absent in 1887, have been inadvertently introduced or have invaded the area. In some sections, riffles and pools have become partially reestablished since the last channelization, resulting in isolated small populations of such species as the Orange-throat Darter (Etheostoma spectabile). (Authors)

18111. Klima, Edward F. (Southeast Fish. Center, NMFS, NOAA, Pascagoula, Mississippi 39567). 1974. ELECTRICAL THRESHOLD RESPONSE OF SOME GULF OF MEXICO FISHES. NOAA Fish. Bull., 72(3): 851-853.

18112. Schindler, D. W., H. E. Welch, J. Kalff, G. J. Brunskill, and N. Kritsch (Dept. of the Environ., Fish. and Mar. Serv., Freshwater Inst., Winnipeg, Manitoba R3T 2N6, Canada). 1974. PHYSICAL AND CHEMICAL LIMNOLOGY OF CHAR LAKE, CORNWALLIS ISLAND (75° N LAT.). J. Fish. Res. Board Can., 31(5): 585-607.

Seasonal data for several physical and chemical variables in Char Lake are given. Annual cycles of major solutes are influenced primarily by freeze-thaw cycles. Concentrations of most substances are increased by freezing-out during the winter. Because the lake does not circulate during maximum spring meltwater flow, this freezing-out maintains concentrations in the lake above those in inflow streams. Concentrations of phosphorus and nitrogen in the lake are low throughout the year. Precipitation contains little phosphorus or nitrogen. Input of phosphorus and nitrogen are calculated to be 0.016 and 0.314 g/m², respectively. Retention of nutrients by the lake is lower than in temperate regions, although still quite efficient. With the exception of silica, return of ions from the sediments during winter was found to be negligible. Disturbance of one inflow stream due to airstrip construction caused great increases in concentrations of nitrogen, silica, chloride, sulfate, and bicarbonate in the stream. (Authors)

18113. Swift, D. J., and R. Lloyd (Salmon and Freshwater Fish. Lab., Min. of Agric., Fish. and Food, Whitehall Place, London SW1A 2HH, England). 1974. CHANGES IN URINE FLOW RATE AND HAEMATOCRIT VALUE OF RAINBOW TROUT Salmo gairdneri (Richardson) EXPOSED TO HYPOXIA. J. Fish Biol., 6(4): 379-387.

Measurements were made of urine flow rates and haematocrit of rainbow trout exposed to hypoxic conditions (3 mg O₂/l) for 3, 4, 5 or 24 h. Elevated urine flow rates during short time exposure and concomitant increased haematocrit, followed by lower than normal urine flow rates on return to normal aerated water, suggest that haemoconcentration is the initial response to anoxia. Results from longer exposure to hypoxic conditions suggest that the initial period of haemoconcentration is followed by a period of water retention and a return of the blood volume to normal; the sustained elevated haematocrit is thought to be derived from release of erythrocytes from storage organs. During prolonged exposure rainbow trout also become more permeable to water. (Authors)

18114. Inglis, Anthony, and Edward L. Davis (Fish-Pesticide Res. Lab., Columbia, Missouri 65201). 1972. EFFECTS OF WATER HARDNESS ON THE TOXICITY OF SEVERAL ORGANIC AND INORGANIC HERBICIDES TO FISH. U. S. Dept. of the Interior, Tech. Papers of the Bur. of Sport Fish. and Wildl. No. 67, 22 p.

Effects of water hardness on the acute toxicity of organic and inorganic herbicides were determined in static bioassays. Concentrations of total hardness (calculated as CaCO₃) of 13.0, 52.2, 208.7, and 365.2 ppm were tested in water containing calcium/magnesium ion ratios of 1:1 and 5:1. Bluegills were the principal test species; rainbow trout, bluespotted sunfish, goldfish, redear sunfish, and black bullheads were also tested. Organic herbicides tested included three formulations of 2,4-D (BEE, PGBEE, DMS), three formulations of endothall (Na salt, and two dimethylalkylamine derivatives), and one formulation each of silvex (BEE), pentachlorophenol, and dichlobenil; inorganic herbicides included technical grades of sodium arsenite and copper sulfate. Hardness had no significant effect on toxicity of the organic herbicides or that of sodium arsenite; the toxicity of copper sulfate decreased in the harder waters. The significance of the results is discussed. (Authors)

18115. Pang, Peter K. T., and Rosemary K. Pang (Dept. of Pharmacol., College of Physicians and Surgeons, Columbia Univ., New York, New York 10032). 1974. ENVIRONMENTAL CALCIUM AND HYPOCALCIN ACTIVITY IN THE STANNIUS CORPUSCLES OF THE CHANNEL CATFISH, Ictalurus punctatus (Rafinesque). Gen. Comp. Endocrinol., 23(2): 239-241.

18116. Nicholson, Bruce L., and James Dunn (Dept. of Microbiol., Univ. of Maine, Orono, Maine 04473). 1974. HOMOLOGOUS VIRAL INTERFERENCE IN TROUT AND ATLANTIC SALMON CELL CULTURES INFECTED WITH INFECTIOUS PANCREATIC NECROSIS VIRUS. *J. Virol.*, 14(1): 180-182.

The occurrence of homologous interference in the replication of infectious pancreatic necrosis virus was demonstrated after successive passages of partially purified virus at high input multiplicities in trout and Atlantic salmon cell cultures. Pretreatment of cell cultures with interfering virus inhibited the replication of homologous standard infectious virus but not unrelated viruses. The ability of infectious pancreatic interfering virus to interfere with homologous virus was abolished with UV irradiation, immune serum, and freeze-thawing. (Authors)

18117. Brock, Julie H., and Richard E. Brock. 1974. THE MARINE FAUNA OF THE COAST OF NORTHERN KONA, HAWAII: AN INVENTORY OF FISHES AND INVERTEBRATES RECORDED DURING SUMMER, 1972. Sea Grant Advisory Report UNIHI-SEAGRANT-AR-74-02, 30 p., illus.

A survey of the marine animals of the Kona coast of the island of Hawaii was undertaken during the summer of 1972 in conjunction with a similar study of the coastal ponds. The shoreline and subtidal waters to a depth of 30 feet (10 m) were surveyed at 16 stations from Makalawena in the north to Waialua near South Point. In total, 163 species of invertebrates and 137 species of fish were recorded from three well-defined habitats: the tidepools, the subtidal waters that receive freshwater runoff from the land, and the true marine subtidal areas. It was not possible to make thorough collections at each station in all three habitats. Consequently the sampling effort varied at each station so the results are not directly comparable. Fish surveys were only made at six of the sixteen stations. Some stations examined are exceptional in their faunal diversity (abundance of species) for both fishes and invertebrates. The subtidal zone with freshwater influence occurring over geologically young lava rock is unique to this island and associated with it is a discrete group of fishes and invertebrates which characterize this habitat. Representative coelenterates, polychaetes, and mollusks can be described as indicator organisms for this low salinity environment. Greatest species diversities are found in the truly marine areas. This report is the first attempt to biologically examine some of the remote marine areas of the Kona coast. The information presented here should be useful to other biologists and for environmental planning by county officials. Recommendations are made for the conservation or preservation of five stations (4, 7, 8, 9, 11) that have either a unique marine fauna or other biological and cultural attributes that are not found elsewhere. Further investigations of these regions are essential for a better understanding of the pristine marine communities present, especially in view of the lack of human disturbance that has occurred along the remote sections of this coast in contrast to many shoreline areas of the Hawaiian Islands. (Authors)

18118. Swingle, Hugh A., and Donald G. Bland (Mar. Res. Div., Alabama Dept. of Conservation and Natural Resources, Dauphin Island, Alabama 36528). 1974. A STUDY OF THE FISHES OF THE COASTAL WATERCOURSES OF ALABAMA. Alabama Marine Resources Bulletin No. 10, pp. 22-102.

Trawl or seine samples were collected monthly at 23 stations within the brackish water zone of the coastal watercourses of Alabama. A total of 104 species of fishes and 19 species of invertebrates was collected from December 1970 through May 1972. Water salinity, temperature and dissolved oxygen values are presented and are correlated to some extent with species abundance and diversity. The species composition of altered and unaltered watercourses and the species composition of estuarine waters are discussed. The number of species of marine, estuarine and freshwater fishes taken was approximately equal, but marine and estuarine individuals made up 96% of the total catch. Marine and estuarine species of fishes and invertebrates dominated the population down to about 2 ppt. Freshwater species were dominant at salinities below 1 ppt but the number of individuals was still exceeded by marine and estuarine species. (Authors)

18119. Fagerström, Torbjörn, Bo Åsell, and Arne Jernelöv (Swedish Water and Air Pollution Res. Lab., Stockholm, Sweden). 1974. MODEL FOR ACCUMULATION OF METHYL MERCURY IN NORTHERN PIKE Esox lucius. *Oikos*, 25(1): 14-20.

A compartmental model of mercury residue accumulation in individual fishes is presented. The model assumes a single residue pool that acquires methyl mercury from respired water and with the diet. Uptake and clearance of residue are treated as functions of metabolic rate, which is itself size-dependent. The parameters for the model are estimated from a release-recapture experiment and from literature data, and the solutions produced by the model when using these estimates are compared with real-world data where the latter set of data is independent of the set that was used for parameter estimation. The correspondence between the calculated concentration of methyl mercury in lateral muscle tissue and empirically observed values is acceptable though the calculated values in the lower weight range are somewhat high. The possibility that the model may apply to other substances is discussed.

18120. Welch, H. E., and J. Kalff (Dept. of Zool., Univ. of Toronto, Toronto, Ontario, Canada). 1974. BENTHIC PHOTOSYNTHESIS AND RESPIRATION IN CHAR LAKE. *J. Fish. Res. Board Can.*, 31(5): 609-620.

Benthic photosynthesis and respiration was measured by in situ oxygen change and correlated with in situ radiation in ultraoligotrophic Char Lake (lat. 74°42'N). Photosynthesis by the moss and deep sediment zones was correlated with light but photosynthesis by the shallow rocky zone was not. Total benthic gross photosynthesis in Char Lake is 47.5 g O₂ m⁻² yr⁻¹, or 80% of the total lake photosynthesis. Benthic respiration was 43.6 g O₂ m⁻² yr⁻¹, in close agreement with the 40.1 g O₂ m⁻² yr⁻¹ derived from whole lake metabolism. Light input is strongly dependent on snow cover and extinction coefficient. Subsurface irradiance is 24% of the photosynthetically available surface radiation. (Authors)

18121. Griffith, J. S., Jr. (Idaho Coop. Fish. Unit., Univ. of Idaho, Moscow, Idaho). 1974. UTILIZATION OF INVERTEBRATE DRIFT BY BROOK TROUT (Salvelinus fontinalis) AND CUTTHROAT TROUT (Salmo clarki) IN SMALL STREAMS IN IDAHO. *Trans. Amer. Fish. Soc.*, 103(3): 440-447.

In four northern Idaho streams I assessed availability of invertebrate drift in summer 1969. Brook and cutthroat trout inhabited two streams sympatrically and two allopatrically. I compared drift and diet components to assess proportion of drift cropped by trout and extent to which trout segregated into dietary niches. Members of five insect orders (Ephemeroptera, Coleoptera, Diptera, Trichoptera and Plecoptera) comprised 97% of the number of drift organisms and an average of 92% of the number of organisms eaten by both brook and cutthroat trout. The terrestrial component of both drift and diet was insignificant, and predation on fish and/or cannibalism was rare. Most Ephemeroptera, Plecoptera and Coleoptera drifted between dusk and dawn when they may not have been available to trout. Trout selected certain food items. Underyearling brook and cutthroat trout differed little in their food preferences or habits, whether they lived sympatrically or allopatrically, and consumed smaller organisms (mainly Diptera and Ephemeroptera). Older trout of each species living allopatrically differed in utilization of Diptera and Trichoptera, with cutthroat selecting the former and brook trout the latter. These differences were intensified in sympatry. (Auth.)

18122. Benke, G. M., and S. D. Murphy (Dept. of Physiol., Kresge Center for Environ. Health, Harvard Univ., School of Public Health, 665 Huntington Avenue, Boston, Massachusetts 02115). 1974. ANTICHLINESTERASE ACTION OF METHYL PARATHION, PARATHION AND AZINPHOSMETHYL IN MICE AND FISH: ONSET AND RECOVERY OF INHIBITION. *Bull. Environ. Contam. Toxicol.*, 12(1): 117-122.

Rates of onset of ACLE inhibition do not explain the greater toxicity of parathion and azinphosmethyl relative to methyl parathion in sunfish. The rate of onset and recovery from ACLE inhibition by all 3 pesticides in fish brain and muscle is much slower than in mice and the slow recovery of ACLE's in fish may make them more susceptible to cumulative injury by these compounds. (Authors' summ.)

18123. Fryer, J. L., and K. S. Pilcher (Oregon State Univ., Corvallis, Oregon 97331). 1974. EFFECTS OF TEMPERATURE ON DISEASES OF SALMONID FISHES. U.S. Environ. Protection Agency, Office of Res. and Development, EPA-660/3-73-020, 114 p.

The effect of water temperature on infections of salmonid fish was investigated. Chondrococcus columnaris infection was studied in rainbow trout, coho and spring chinook salmon; Aeromonas salmonicida infection in coho and spring chinook salmon; and Aeromonas liquefaciens infection in steelhead trout. In all cases mortality rates were high at 64° to 69°F; moderate at 54° to 59°F; and low or zero at 39° to 49°F. Progress of the infections was accelerated at higher temperatures, and progressively retarded at decreasing temperature levels. In infection of coho with Ceratomyxa shasta, mortality was high at 69°F, low at 49° to 54°, and zero at 39° to 44°F. This infection in rainbow trout resulted in high mortality at all temperatures except 39°. In both cases the course of the disease was most rapid at higher temperatures, and became progressively slower as the temperature decreased. For infection of kokanee salmon fingerlings with sockeye salmon virus, the temperature range of 54° to 59°F was optimal. In this range mortality rates were high, and the course of the disease most rapid. At higher temperatures mortality rates were lower, and at 39° to 44°F, progress of the disease was retarded, though total mortality was often high. (Authors)

18124. Festa, Patrick J. (N. J. Dept. of Environ. Protection, Nacote Creek Res. Sta., Absecon, New Jersey 08201). 1974. ESTIMATION OF TOTAL LENGTH IN STRIPED BASS VIA MEASUREMENT OF VERTEBRAL AND FILLET LENGTHS. N. J. Dept. of Environ. Protection Miscellaneous Report No. 9M, 11 p. + 12 figs.

Fifty striped bass, Morone saxatilis, specimens were used to develop regression equations relating total length to various fillet and vertebral segment lengths. Fifteen measurements were made on each fish and equations developed for nine of these. Using 99% confidence intervals a series of critical lengths, which distinguish fish under 18 inches in total length, was derived. The best measurements will identify a 17 inch fish with an upper confidence limit under 18 inches. The equations may be of value in present enforcement of size limit regulations on this species; however, broader legislation to prohibit mutilation of captured fish appears to be the only practical means of solving the enforcement problem. (Auth.)

18125. Tyus, Harold M. (Dept. of Zool., No. Carolina State Univ., Raleigh, No. Carolina 27607). 1974. MOVEMENTS AND SPAWNING OF ANADROMOUS ALEWIVES, Alosa pseudoharengus (Wilson) AT LAKE MATTAMUSKEET, NORTH CAROLINA. Trans. Amer. Fish. Soc., 103(2): 392-396.

Adult anadromous alewives were captured during spring spawning runs into Lake Mattamuskeet, North Carolina in 1969, 1970 and 1971. The peak of the spawning runs occurred on 5 and 6 April 1970, and 2 and 3 April 1971. Average water temperatures on these dates were 12.9 C and 13.1 C, respectively. Seasonal movements of alewives displayed a unimodal peak. Daily activity was greatest between dawn and noon and between dusk and midnight. One of four canals connecting the spawning grounds in the lake with Pamlico Sound carried an average of 97.5% of the alewives into the lake during 1970 and 1971. (Auth.)

18126. Kerstetter, Theodore H., and Leonard B. Kirschner (Dept. of Biol., California State Univ. - Humboldt, Arcata, California 95521). 1974. HCO₃⁻-DEPENDENT ATPase ACTIVITY IN THE GILLS OF RAINBOW TROUT (Salmo gairdneri). Comp. Biochem. Physiol., 48(4B): 581-589.

A HCO₃⁻-activated ATPase is present in both fresh water and sea water adapted rainbow trout gills. The apparent K_m for HCO₃⁻ is 0.016 M. Both the ATPase and active Cl⁻ uptake by intact gills are inhibited by SCN⁻, but by apparently independent mechanisms. Cl⁻ is not required for activation of the ATPase; at [Cl⁻] greater than 0.010 M, enzyme activity is inhibited. The intracellular location of the HCO₃⁻-ATPase is unclear, but preliminary evidence suggests it is both mitochondrial and microsomal. (Authors)

18127. Symons, Philip E. K. (Dept. of the Environ., Biol. Sta., St. Andrews, New Brunswick, Canada). 1974. TERRITORIAL BEHAVIOR OF JUVENILE ATLANTIC SALMON REDUCES PREDATION BY BROOK TROUT. *Can. J. Zool.*, 52(6): 677-679.

Brook trout (*Salvelinus fontinalis*) ate 26% of 58 juvenile (7-11 cm) Atlantic salmon (*Salmo salar*) introduced into an artificial stream 24 h before the trout, but they ate only 8% of 60 salmon which had been present long enough to establish territories. Man-made environmental alterations may decrease territorial behavior of young salmon thereby increasing their vulnerability to predation. (Auth.)

18128. Morrow, J. E. (Dept. of Biol. Sciences, Alaska Univ., College, Alaska). 1974. EFFECTS OF CRUDE OIL AND SOME OF ITS COMPONENTS ON YOUNG COHO AND SOCKEYE SALMON. Environ. Protection Agency, Ecological Res. Series Report EPA-660/3-73-018, 37 p, 20 tab.; Selected Water Resources Abstracts, 7(15): p. 48.

Young coho and sockeye salmon, acclimated to 30 ‰ salinity, were exposed in various ways to different amounts of crude oil from the Prudhoe Bay field. Oil poured on the surface of the water in 95 liter (25 gallon) aquaria produced significant mortalities when the oil concentration was 500 ppm or greater. Fish dipped into a crude oil film, or with a drop of oil placed directly on each gill, showed no significant mortalities. The same was true of fish force-fed crude oil at 1 g per 100 g body weight. Oil that had been exposed to air for 30 days produced no significant mortalities. Among oil components tested for toxicity on coho salmon, aliphatic compounds were not lethal. Mono-cyclic aromatics were generally toxic, the degree of toxicity increasing with the degree of unsaturation. It is suggested that the toxicity of these substances is brought about through alteration of cell membrane permeability, especially in the gills. This results in a rapid increase of mono-valent ions in the blood and probably also interferes with $\text{CO}_2\text{-HCO}_3$ regulation.

18129. Guthrie, Richard C., John A. Stolgitis, and W. Leigh Bridges (Rhode Island Dept. of Nat. Res., Div. of Fish & Wildl., Providence, Rhode Island). 1973. PAWCATUCK RIVER WATERSHED FISHERIES MANAGEMENT SURVEY. R. I. Div. of Fish and Wildlife, Fish. Report No. 1, 61 p. + appendixes.

Tagging and stocking of 11,351 trout resulted in voluntary tag returns of 31.7%. Rainbow trout yielded the highest return percentage of 37.2%, compared to returns for brook and brown trout of 29.6 and 27.2%, respectively. Tag returns from brook trout were highest from pre-season stocking. Rainbow and brown trout showed best returns from inseason stockings. Autumn stocking was only one-third as successful, in terms of percentage of tag returns, as spring stocking. Larger streams, particularly those on state lands, yielded the highest percentages of returns. More than three-fourths of all tags were returned in the first eight weeks of the season and within one-half mile of the stocking site. Survival of hatchery trout was insignificant with only 23 tags returned the following year. Brown trout predominated in the carry-over fish. Summer rotenone sampling also revealed brown trout survival to be much higher than that of brook and rainbow trout. Pollution in the Pawcatuck River basin was most significant on the main river between Kenyon and tidewater. Continuous temperature and dissolved oxygen monitoring in 1971 disclosed that occasional low oxygen levels occurred in summer. Population sampling on 48 streams yielded 30 freshwater species. Eastern brook trout were the most abundant species in the collections: although redbfin pickerel were collected at a greater number of stations. The suitability of brook trout habitat was reflected in the relative abundance of this species and its competitors. Collections from productive brook trout streams yielded few competing species, and these usually were small in size and of low standing crop. White suckers and fall-fish dominated collections from marginal trout streams and larger warm water streams. Naturally reared brown trout were collected from six stations. These consisted of young of the year and yearling fish averaging 7.7 inches at time of capture. No evidence of naturally spawned rainbow trout was found. Rotenone collections in cold water streams disclosed a mean standing crop of brook trout of 49 pounds per acre. Trout over 6.5 inches comprised 10.3% of the collections

of this species. Growth of brook trout, based on the mean length and age at the time of capture, was: Age I+, 6.6 inches; Age II+, 8.5 inches; Age III+, 10.0 inches. The growth of brook trout compared favorably with growth data from Massachusetts, New Hampshire and Maine. Only one brook trout of age III+ was collected. In six streams no brook trout over age I+ were taken. Survival estimates on three streams showed survival from age 0 to age I to be 11.7% and survival from age 0 to age II to be 1.9%. Collections from the larger tributary streams and the main Pawcatuck River revealed domination by "trash" fish and panfish of marginal desirability. Nineteen species were collected in the sampling on 18 ponds. Largemouth bass, chain pickerel, and smallmouth bass constituted 22.1% by weight of the collections. Panfish comprised 58.7% and "weed" species 19.2%. The growth rate of largemouth bass, yellow perch, bluegill and common sunfish were slightly above the average for the state. White perch growth was below the state average, reflecting overabundance in several ponds. Chain pickerel growth approximated the state average. The first collections of landlocked alewives, northern rock bass and white catfish were recorded in this survey. A decline in smallmouth bass populations over past years was indicated by collection data. Further knowledge was gained on the range of the yellow-bellied sunfish in the watershed. (Authors' summ.)

18130. Hoagman, Walter J. (Virginia Inst. of Mar. Sci., Gloucester Point, Virginia 23062). 1973. THE HATCHING, DISTRIBUTION, ABUNDANCE, GROWTH, AND FOOD OF THE LARVAL LAKE WHITEFISH (Coregonus clupeaformis Mitchill) OF CENTRAL GREEN BAY, LAKE MICHIGAN. Inst. of Freshwater Research, Drotningholm, Report No. 53, pp. 1-20.

This study represents only the fourth contribution on wild larvae of the lake whitefish in North America, and the first on the Lake Michigan stock. This study was performed in Central Green Bay and adjacent Lake Michigan because it has remained a productive whitefish area. It provides basic information on larval whitefish distribution, development, times of hatching, movement, feeding, yolk-sac conversion, densities, growth, and interspecific relationships. In essence it summarizes the entire findings from the field. (From Auth. introduction)

18131. Kalff, J. and H. E. Welch (Dept. of Biol., McGill Univ., Montreal, Quebec, Canada). 1974. PHYTOPLANKTON PRODUCTION IN CHAR LAKE, A NATURAL POLAR LAKE, AND IN MERETTA LAKE, A POLLUTED POLAR LAKE, CORNWALLIS ISLAND, NORTHWEST TERRITORIES. J. Fish. Res. Board Can., 31(5): 621-636.

Phytoplankton production of ultraoligotrophic Char Lake and polluted Meretta Lake (lat. 74° 42'N; long. 94° 50'W) were studied between 1969 and 1972. Phytoplankton production in Char Lake is approximately 4.1 g Cm⁻²yr⁻¹, making it the most oligotrophic lake on record. Photosynthesis takes place virtually the whole 9 mo the sun comes above the horizon. Changes in depth of maximum photosynthesis, in efficiency of low light utilization, and in optimal light flux resulted in a much more constant production rate than suggested by the light input, which is importantly affected by amount of snow cover. Phytoplankton in nearby sewage-polluted Meretta Lake averages 11.3 g Cm⁻²yr⁻¹, and chlorophyll concentrations are 20 times higher than in Char Lake. Nutrient deficiencies, especially of phosphorus, are almost certainly responsible for the low efficiency of light utilization and resulting low production in Char Lake. Benthic production is of major significance in both lakes. (Authors)

18132. Rawson, Mac V., Jr., and Alfred C. Fox (Ga. Coop. Fish. Unit, School of Forest Res., Univ. of Ga., Athens, Georgia 30601). 1974. AN EVALUATION OF ANTIMYCIN A AS A PARASITICIDE. Trans. Amer. Fish. Soc., 103(3): 618-620.

The parasitocidal activity of Antimycin A was tested against Cleidodiscus pricei Mueller, 1936 on fingerling and adult channel catfish, Ictalurus punctatus (Raf.). C. pricei was eliminated from two groups of fingerlings after 24 hr and 48 hr at Antimycin A concentrations of 0.5 µg, 1.0 µg, and 5.0 µg/liter. In two field tests, C. pricei was eliminated from adults after 48 hr of Antimycin A concentrations at 1.0 µg and 3.5 µg/liter. (Authors)

18133. Boyd, John F., and Richard C. Simmonds (Northrop Services, Inc., P. O. Box 34416, Houston, Texas 77034). 1974. CONTINUOUS LABORATORY PRODUCTION OF FERTILE Fundulus heteroclitus (Walbaum) EGGS LACKING CHORIONIC FIBRILS. J. Fish Biol., 6(4): 389-394.

A brood stock of Fundulus heteroclitus (Walbaum) minnows was established at the Johnson Space Center in Houston, Texas. By use of the aquarium maintenance system described in this report the fish were induced to produce fertile eggs throughout the year. Additional data is presented to confirm that F. heteroclitus found in the vicinity of Beaufort, North Carolina produce eggs which lack chorionic fibrils, making them especially suitable for use in embryo development studies. (Authors)

18134. Lake, W., and J. S. Loch. 1973. A MOBILE FIELD LABORATORY FOR AQUATIC TOXICITY STUDIES. Environ. Canada, Resource Mgmt. Branch, Central Region, Technical Report Series No. CEN/T-73-13, 52 p.

A 52' mobile bioassay laboratory was designed in order to conduct static and flow-through temperature controlled bioassays and resource surveillance studies at industrial sites. Modifications, problems encountered, solutions arrived at and recommendations on the feasibility of such a design are discussed. It was found that for short field projects which require a mobile laboratory, a laboratory of the size used in this study was not practical. The trailer as described in this report is best used in prolonged field studies (2 months or more) due to the logistic problems inherent in moving and re-establishing a trailer of such a large size. A smaller, more compact and self-sufficient mobile laboratory is suggested for field work. This laboratory would be easier to transport and set-up time could be shortened considerably. As a research unit, a 52' mobile laboratory is ideal for bioassays. (Authors)

18135. McKinney, E. C., S. B. Smith, and M. M. Sigel (Univ. of Miami School of Medicine, Miami, Florida). 1974. STUDIES ON THE FUNCTION OF FISH LEUKOCYTES AND THROMBOCYTES. In vitro, 9(5): 367, abstract 62; Fish Health News, 3(3): p. 11.

The purpose of these experiments was to delineate the function of thrombocytes and the phagocytic capabilities of white cells of the gar, Lepisosteus platyrhincus. The gar was bled into heparin, and the whole blood placed in a siliconized Petri dish containing coverslips. A small amount of bacteria or yeast was added to the blood. The dish was then placed on a rocker platform. At various intervals a coverslip was removed, washed thoroughly, stained, and examined. Several occurrences were observed. Initially the thrombocytes formed clumps on the glass with the micro-organisms then adhering to the clumps. Monocytes also adhered to the glass in far fewer numbers. Both the monocytes and the thrombocytes appear to phagocytize the organisms. Eosinophils adhered to the thrombocyte clumps in numbers greatly disproportionate to their distribution in the blood. However, they lacked phagocytic activity. These findings suggest that the thrombocytes play an important role in nonspecific host resistance by providing a mechanism for concentrating granulocytes. Lastly, the rapidity of these reactions is greatly retarded compared to those of mammals. (Authors)

18136. Lackey, Robert T. (Dept. of Fish. and Wildl. Sciences, Virginia Polytechnic Inst. and State Univ., Blacksburg, Virginia 24061). 1974. PRIORITY RESEARCH IN FISHERIES MANAGEMENT. Wildl. Soc. Bull., 2(2): 63-66.

Research can contribute to solving some of the complex decision-making problems in natural resource management. In fisheries management, priority research areas are identified as (1) formalization of management objectives or objective functions, (2) clarification of the decision-making process, (3) development of methodology to evaluate decisions to determine how well decisions have worked, and (4) development of sound models that can be effectively used in evaluating decision alternatives. These four research areas are amenable to university research environments, and significant research along any of these lines would enhance decision-making. (Auth.)

18137. Shaklee, James B., Michael J. Champion, and Gregory S. Whitt (Provisional Dept. of Genetics and Development, Univ. of Ill., Urbana, Illinois 61801). 1974. DEVELOPMENTAL GENETICS OF TELEOSTS: A BIOCHEMICAL ANALYSIS OF LAKE CHUBSUCKER ONTOGENY. Dev. Biol., No. 38, pp. 356-382.

Developing embryos of the lake chubsucker, Erimyzon sucetta, were analyzed with regard to both gross morphological changes and specific enzymatic changes from the unfertilized egg stage until some 3 weeks posthatching. Total activities of three enzymes - lactate dehydrogenase, glucose-6-phosphate dehydrogenase, and isocitrate dehydrogenase - were determined throughout the course of development. Each of these different enzymes exhibited a different pattern of change during ontogeny. Electrophoretic analysis of qualitative changes in isozyme patterns was accomplished for these three enzymes and for α -amylase, glucosephosphate isomerase, mannosephosphate isomerase, creatine kinase, esterase, glutamate dehydrogenase, alkaline phosphatase, aspartate aminotransferase, malate dehydrogenase, hexose diphosphatase, phosphoglucomutase, and phosphogluconate dehydrogenase. Many of the enzyme systems investigated exhibited rich patterns of ontogenetic change, while a few remained relatively unchanged throughout the interval studied. Several of the enzymes in particular metabolic pathways exhibited coincident changes suggestive of coordinate control. The appearance of several rather "tissue-specific" isozymes was closely correlated with the morphological and functional differentiation of these particular tissues or organs. (Authors)

18138. Stanley, Jon G. (U.S. Fish and Wildl. Serv., Fish Farming Exp. Sta., Stuttgart, Arkansas 72160). 1974. ENERGY BALANCE OF WHITE AMUR FED EGERIA. Hyacinth Control Journal, Vol. 12, pp. 62-66.

A study of energy balance revealed that 1-kg white amur (Ctenopharyngodon idella Val.) inefficiently assimilated Egeria (Egeria densa Planch.) but that a low metabolic rate allowed efficient conversion of assimilated food into fish biomass. Food intake (96 kcal) minus egestion (40 kcal) balanced within experimental error the sum of respiration (8 kcal) and growth (74 kcal). Although food contained largely carbohydrates, metabolism of protein accounted for 63% of the respiration, whereas carbohydrates were converted largely to fat. (Auth.)

18139. Stromberg, Paul C., and John L. Crites (Dept. of Zool. and the Center for Lake Erie Area Res., Ohio State Univ., Columbus, Ohio 43210). 1974. THE LIFE CYCLE AND DEVELOPMENT OF Camallanus oxycephalus Ward and Magath, 1916 (NEMATODA: CAMALLANIDAE). J. Parasitol., 60(1): 117-124.

The life cycle of Camallanus oxycephalus Ward and Magath, 1916, is experimentally completed and the development of the larval stages described. Ovoviparous females rupture in lake water and release infective first-stage larvae. When eaten by copepods (Cyclops vernalis and C. bicuspidatus) the larvae penetrate through the gut wall into the hemocoel. The first molt occurs on the 3rd day after infection at 25 C and second molt on the 6th day after infection. Third-stage larvae have a partially sclerotized, 2-chambered buccal capsule, 3 mucrones on the tail, and lie coiled in the hemocoel. Bile stimulates activity of the quiescent larvae and escape from the copepod carcass occurs in the stomach or small intestine of fishes. The 3rd molt occurs 18 days after infection in male worms and 24 days after infection in female worms. The life cycle may be completed directly from copepods to the final host but developing larvae may also be transferred from small infected forage fish to piscivorous species. Previous work on camallanid life cycles and the probable life cycle in western Lake Erie are discussed. (Authors)

18140. Buchanan, Thomas M. (Dept. of Natural Sci., Westark Community Coll., Fort Smith, Arkansas 72901). 1973. CHECKLIST OF ARKANSAS FISHES. Ark. Acad. of Sci., Vol. 27, pp. 27-29.

Arkansas has a large, diverse fish fauna consisting of 193 species known to have been collected from the state's waters. The checklist is an up-to-date listing of both native and introduced species, and is intended to correct some of the long-standing and more recent erroneous Arkansas records. (Auth.)

18141. Perez, Julio E., and Norman Maclean (Dept. of Biol., Univ. of Southampton, SO9 3TU, England). 1974. ONTOGENETIC CHANGES IN HAEMOGLOBINS IN ROACH, Rutilus rutilus (L.) AND RUDD, Scardinius erythrophthalmus (L.). J. Fish Biol., 6(4): 479-482.

The haemoglobins and globins of the roach, Rutilus rutilus (L.) and the rudd, Scardinius erythrophthalmus (L.) have been studied by starch gel electrophoresis. At all stages of development studied, the roach and rudd haemoglobins give a similar electrophoretic pattern, the young fish of about 2 cm standard length possessing three separate haemoglobins, of which two bands only persist in the adult. The evolutionary significance of multiple haemoglobins in fishes is briefly discussed. (Authors)

18142. Havey, Keith A. (Maine Dept. of Inland Fisheries and Game, Bangor, Maine). 1974. POPULATION DYNAMICS OF LANDLOCKED SALMON, Salmo salar, IN LOVE LAKE, MAINE. Trans. Amer. Fish. Soc., 103(3): 448-456.

Population dynamics of landlocked salmon, Salmo salar, were investigated at Love Lake, Washington County, Maine from 1959-71. Survival of one lot of hatchery-reared fish from age II-III was 14%; survival of three lots from age III-IV ranged from 20-49%; survival of one lot from age IV-V and one lot from age V to VI was 34% and 32%, respectively. The rates compared favorably with those from well known Maine salmon waters and also with those of naturally-reared fish. Those stocked in fall at age I+ survived much better than those stocked in spring at age I. There is a linear relationship ($p < 0.01$) between average weight of salmon stocked and their recoveries by trapnetting. Those that weighed less than 35 g when stocked survived poorly. Growth of salmon at Love Lake compared favorably with the average growth in 15 Maine salmon lakes. Mean standing crop of salmon age III and older from 1963-69 was 1.4 salmon/ha weighing 0.6 kg/ha. Spring standing crops can be predicted by the linear regression formula $Y = 100 + 8.78 X$ where X is catch of salmon per net hour X 1,000 ($p < 0.01$). Both hatchery and naturally-reared salmon used the inlet of Love Lake for spawning rather than the outlet. Attempts to establish spawning runs to the outlet by stocking juveniles and relocating ripe adults there failed. (Auth.)

18143. Rigler, F. H., M. E. MacCallum, and J. C. Roff (Dept. of Zool., Univ. of Toronto, Toronto, Ontario, Canada). 1974. PRODUCTION OF ZOOPLANKTON IN CHAR LAKE. J. Fish. Res. Board Can., 31(5): 637-646.

Production of the most abundant zooplankton in a polar lake was studied over 4 yr. Limnocalanus macrurus produced $261 \text{ mg m}^{-2} \text{ yr}^{-1}$ ash-free dry weight and Keratella cochlearis produced $3 \text{ mg m}^{-2} \text{ yr}^{-1}$. Neither population fluctuated violently from year to year and mortality rates of both were low. Limnocalanus macrurus assimilation was equivalent to 73% of the annual planktonic primary production, and its respiration equal to 6% of the annual lake metabolism. Ciliated protozoa probably produce more than K. cochlearis, but far less than L. macrurus. Cross-calibration of sediment traps and zooplankton traps suggested that exuviae collected in sediment traps can be used to measure crustacean zooplankton production. (Authors)

18144. Harima, Hector, and Philip R. Mundy (Univ. of Alabama, Dept. of Biol., P.O. Box 1927, University, Alabama 35486). 1974. DIVERSITY INDICES APPLIED TO THE FISH BIOFACIES OF A SMALL STREAM. Trans. Amer. Fish. Soc., 103(3): 457-461.

The numerical and biomass structures of the fish biofacies from a small stream were studied by means of diversity indices. Biweekly samples taken over a year's period showed temporal fluctuations within a narrow range of variation. Seasonal changes in species composition had very little effect on the overall numerical structure of the fish biofacies, as species richness and diversity indices based on numbers of individuals showed stability throughout the year. Contrastingly, the number of species per collection and diversity indices based on biomass exhibited seasonal variations in response to seasonal changes. In total, the numerical structure of the fish-biofacies was controlled by the persistent dominance of a few resident species. (Authors)

18145. Hargens, Alan R., Ronald W. Millard, and Kjell Johansen (Dept. of Zoo-Physiol., Univ. of Aarhus, DK-8000 Aarhus C, Denmark). 1974. HIGH CAPILLARY PERMEABILITY IN FISHES. *Comp. Biochem. Physiol.*, 48(4A): 675-680.

Protein concentration in extravascular fluid is almost equal to plasma protein concentration in cod (*Gadus morhua*) and flounder (*Pleuronectes platessa*). The high extravascular protein concentration in fishes suggests a high capillary permeability to proteins, and thus, the effective colloid osmotic pressure across the capillary membrane is much less than that predicted by plasma protein concentration alone. Since protein permeability is high through their capillary membrane, polar fishes can tolerate substantial changes in plasma protein concentration without corresponding adjustments in blood hydrostatic pressure. Plasma protein retention in blood correlates directly with blood hydrostatic pressure on a comparative ascending scale in vertebrates: fishes, amphibians, reptiles, mammals and birds. (Authors)

18146. Gowing, Howard, and Walter T. Momot. 1974. POPULATION DYNAMICS OF TROUT, WITH CRAYFISH AS FOOD, IN THREE POTHOLE LAKES IN MICHIGAN. Mich. Dept. of Nat. Res., Fisheries Res. Report No. 1811, 70 p.

In the fall of 1965, populations of brook trout (juvenile and adult) were established in three pothole lakes in the Pigeon River area, at densities of 188, 411, and 1,399 fish per hectare. The lakes were closed to fishing; fish removal was limited to monthly samples for study of food consumption and growth. Population estimates were made periodically of surviving trout, and of an abundant species of crayfish. The trout populations diminished drastically (by 89 to 99%) over a 2-year period, due mostly to natural mortality rather than to our sampling. Heaviest mortality occurred during either the first winter, or the first summer, related to high vs. low density. Growth was related to trout density and to food consumption. Crayfish made up 13% of the trout's diet in one lake, and a high of 71% in the third lake. Trout ate only age-0 crayfish; obviously the older crayfish were too large. Trout consumed as little as 1%, but as much as 43%, of the annual production of age-0 crayfish in the three lakes, but apparently did not "stress" the crayfish population. During a second 2-year period, rainbow trout and brook trout were compared in two lakes, starting with like stocking rates and size of fish. The rainbow did better in survival and in production (44 kg/ha) than did the brook trout (14 kg/ha). The rainbow fed more on cladocerans; the brook trout more on crayfish. (Authors)

18147. Aoki, Takashi (Lab. of Aquaculture Biol., Dept. of Fish., Faculty of Agric., Univ. of Tokyo, Tokyo, Japan). 1974. STUDIES OF DRUG-RESISTANT BACTERIA ISOLATED FROM WATER OF CARP-PONDS AND INTESTINAL TRACTS OF CARP. *Bull. Jap. Soc. Sci. Fish.*, 40(3): 247-254. In Japanese with English tables.

Multiple drug resistant gram-negative bacteria were isolated from the intestinal tracts of cultured carps and also from the water of five carp-ponds at Shioda Town in Nagano Prefecture, during the period from May to October, 1970. The isolated bacteria were *Aeromonas liquefaciens*, *Pseudomonas*, *Enterobacteriaceae* and *Vibrio*. Transferable R factors were detected in 189 of 425 strains of *A. liquefaciens* and 2 of 25 strains of *Enterobacteriaceae*. These R factors were classified into fi-type and most of them (91.6%) were resistant to both sulfonamides (SA) and tetracycline (TC). During the sampling period, there were epidemics of bacterial infection of carp in 3 of the 5 ponds investigated and sulfonamides were used for treatment. Probably due to this treatment, a marked increase in SA-resistant (grown on nutrient agar containing 500 µg/ml of SA) and TC-resistant (grown on nutrient agar containing 25 µg/ml of TC) bacteria carrying R factors in the intestinal tracts of carp was recognized. (Auth.)

18148. Misitano, David A., and Carl W. Sims (Northwest Fish. Center, NMFS, NOAA, 2725 Montlake Blvd East, Seattle, Washington 98112). 1974. UNUSUAL OCCURRENCE OF AN EASTERN BANDED KILLFISH IN THE LOWER COLUMBIA RIVER. *NOAA Fish. Bull.*, 72(3): 855.

18149. Schreck, Carl B. (Dept. of Fish. and Wildl. Sciences, Virginia Polytechnic Inst. and State Univ., Blacksburg, Virginia 24061). 1974. CONTROL OF SEX IN FISHES. Sea Grant and V.P.I. and S.U. Press, VPI-SG-01: 106 p.

An up-to-date understanding of the scope and limitations of our knowledge basic to the art of controlling the sex of fishes, in addition to its philosophical scientific interest, has pragmatic implications for fisheries management. How does a fish become male or female? How does it come to function as a male or female, or change its function from one to the other? What factors intrinsic to the fish and what factors extrinsic to the fish regulate the observed events of its reproductive processes? How can the sex of a fish be determined at will and, after it has already become differentiated as to sex, how can its reproductive function be manipulated for the benefit of human society? Three chapters attempt to provide a concise account of the progress already made toward answering these questions, while revealing some pitfalls of oversimplification and some already obvious tasks that remain to be carried out before further progress in the areas of research concerned can be accelerated. If these accounts fall short of providing a multidimensional model of sex regulation in teleost fishes, perhaps they will at least give the researchers in various specialties a synoptic apprehension of the complex of problems of which their immediate concerns are only a part. R. W. Harrington's discussion of "Sex determination and differentiation in fishes" lays the foundation on which the other two papers build. V. L. de Vlaming considers "Environmental and endocrine control of teleost reproduction" in fish in which the sex has already been established. Finally, I briefly review "Hormonal treatment and sex manipulation in Fishes" in induced sex reversal, or the experimentally controlled production of fish of the sex (phenotypic sex) that is the opposite of their inherited sex (genotypic sex). (Auth.)

18150. U. S. Dept. of Commerce. 1974. REPORT OF THE NATIONAL MARINE FISHERIES SERVICE FOR THE CALENDAR YEAR 1973. U.S. Dept. of Commerce, NOAA, NMFS, Washington, D. C., 96 p.

18151. Festa, Patrick J. 1974. A STUDY OF THE DISTRIBUTION OF YOUNG AND LARVAL SUMMER FLOUNDER IN NEW JERSEY ESTUARINE WATERS. New Jersey Dept. of Environ. Protection, Nacote Creek Res. Sta. Misc. Report No. 11M, 22 p. + 8 figs.

In 1962 a search of New Jersey estuarine and offshore areas was initiated as a first step in a study to determine the distribution of summer flounder egg, larvae, and young within and adjacent to state waters. A variety of sampling gears and procedures were employed to locate concentrations and determine temporal and spacial occurrence of these developmental stages. Offshore plankton sampling revealed that eggs were widely distributed over the continental shelf with most frequent occurrence in the twenty to forty fathom zone. Findings serve to further document an October and November spawning period off New Jersey. Larvae and young were collected from a number of estuaries demonstrating that New Jersey waters do act as nursery areas for the species. The number of larvae collected in estuarine sampling was generally low throughout the study and their occurrence sporadic. Because of this low occurrence, work was essentially limited to reconnaissance activities. Larvae were collected from inlet areas from early October until March. Young flounder were collected from six estuarine systems. (Auth.)

18152. Gee, John H., Kazimierz Machniak, and Sandra M. Chalanchuk (Dept. of Zool., Univ. of Manitoba, Winnipeg, Manitoba, Canada). 1974. ADJUSTMENT OF BUOYANCY AND EXCESS INTERNAL PRESSURE OF SWIMBLADDER GASES IN SOME NORTH AMERICAN FRESHWATER FISHES. J. Fish. Res. Board Can., 31(6): 1139-1141.

All 12 species of physostomes and 8 species of physoclists altered their buoyancy in response to a change in water velocity. All species showed excess internal pressure of swimbladder gases. (Authors)

18153. Steffens, Werner (Inst. für Binnenfischerei, Berlin-Friedrichshagen, Germany). 1974. THE VITAMIN REQUIREMENTS OF RAINBOW TROUT (*Salmo gairdneri*). [Der Vitaminbedarf der Regenbogenforelle (*Salmo gairdneri*)]. Internationale Revue der Gesamten Hydrobiologie, 59(2): 255-282.

A sufficient supply of vitamins is of major importance in Salmonidae feeding. Therefore considerable amounts of vitamins must be added to complete mixed feed for rainbow trout. The author gives a survey of the function of the various vitamins in the organism and describes the vitamin deficiency symptoms found on Salmonidae, especially on rainbow trout. Finally, recommendations are given for the vitaminization of mixed feed for rainbow trout. (Auth.)

18154. Wilkes, Haldor Marvin, and John K. Beadles (Div. of Biol. Sci., Arkansas State Univ., State University, Arkansas 72467). 1972. SOME PHYSICOCHEMICAL PARAMETERS AND PHYTOPLANKTON STANDING CROP IN FOUR NORTH-EAST ARKANSAS COMMERCIAL FISH PONDS. Proc. of Ark. Acad. of Sci., Vol. 26, pp. 19-26.

Physicochemical conditions and chlorophyll *a* standing crop were studied from July 1970 through June 1971 in four commercial catfish ponds at the Arkansas State University Experiment Farm near Walcott, Greene County, Arkansas. Determinations of dissolved oxygen, free carbon dioxide, total alkalinity, temperature, pH, transparency, and chlorophyll *a* standing crop were made at two-week intervals except during fish harvesting operations. One diurnal measurement of dissolved oxygen, free carbon dioxide, and temperature was conducted 25-26 June 1971. Increased oxygen concentrations coincided with increased chlorophyll *a* concentrations. Free carbon dioxide and chlorophyll *a* values varied inversely throughout the study. Diurnal concentrations of free carbon dioxide were greatest between 0300 and 0700 hours. Phenolphthalein and total alkalinity values fluctuated throughout the study period, and could not be correlated with other parameters measured. Thermal stratification occurred during the summer and was more pronounced in the more turbid ponds. Diurnal temperature measurements indicated that stratification was diurnal. An inverse relationship was found between carbon dioxide and hydrogen-ion concentrations, and all ponds were essentially alkaline. Transparency was relatively constant before the ponds were drained but increased when the ponds were refilled. Suspended particulate matter contributed significantly to turbidity. Peaks of chlorophyll *a* concentration were found in summer, early autumn, and late winter. (Authors)

18155. Zanini, E., S. Andruetto, E. Vigliani, and P. Ghittino (Istituto di Chimica Agraria, Via Pietro Giuria, 15, 10126 Torino, Italy). 1974. RESEARCH ON POSSIBLE DIETARY MERCURY POLLUTION IN FISH FARMING. Riv. It. Piscic. Ittiop., 9(1): 7-12.

The authors briefly emphasize the importance of mercury pollution in fish, and the possible risk to consumers. Intoxication by Hg has not yet been reported in fish farming, and farmed fish are generally considered more safe than fish caught in open polluted waters. To further confirm this assumption, the authors initiated research to ascertain the extent of mercury pollution in fish farming by starting with trout farming, which in Italy is of capital importance. Fish meal, which is heavily represented in trout pellet formulations, may be a hypothetical source of mercury pollution. The authors studied the values of mercury pollution in trout feeds and in their ingredients, in farmed trout, and in trout farm ponds. Simultaneously, groups of trout were fed with commercial feeds containing 0.06 ppm Hg, and also diets with known amounts of inorganic (HgCl_2) and organic ($\text{CH}_3\text{O}-\text{C}_2\text{H}_4-\text{HgCl}$) mercury compounds added. These diets contained 10 ppm Hg and were fed for two months. Total mercury was established with Atomic Absorbment Spectrophotometry (AAS), with analysis without flame, according to other authors. In 14 trout feeds and their ingredients sampled on the Italian market in 1972, the total mercury varied from 0.01 to 2.68 ppm. A meat meal contained 0.14 ppm, five fish meals had 0.07-0.51 ppm. In rainbow trout, fed with pellets with 1.29 ppm, 0.11 (intestine) to 0.55 (liver) were detected. Pond sediments in a fish farm contained from 0.16 to 1.15 ppm Hg, which indicated a certain accumulation in fish ponds. Trout which received for a month a dry diet with 0.06 ppm Hg

had a residue in the body of 0.101 ppm Hg. Trout receiving an experimental diet with 10 ppm Hg accumulated the compound in the body without being intoxicated; Hg residues increased after 3 months (0.235 at start) to 0.140 ppm in trout fed with inorganic Hg and to 1.807 with organic Hg; trout eliminated important amounts of Hg through the faeces, which might contain up to 8.487 ppm. Mercury appeared to be accumulated mostly in the trout liver and less in the edible part. Trout appeared to be able to eliminate great amounts of mercury. All the values found in the edible part are far from the values considered toxic to the consumers, which might interfere with the consumption of farmed trout, and always inferior to the limits imposed by USA and Italian legislation (0.5-0.7 ppm Hg). (Authors' summ.)

18156. Olson, K. R., and P. O. Fromm (Mich. State Univ., Dept. of Physiology, East Lansing, Michigan 48824). 1973. A SCANNING ELECTRON MICROSCOPIC STUDY OF SECONDARY LAMELLAE AND CHLORIDE CELLS OF RAINBOW TROUT (*Salmo gairdneri*). Z. Zellforsch., Vol. 143, pp. 439-449; Selected Water Resources Abstracts, 7(15): p. 59, 1974.

Scanning electron micrographs of gill tissue from rainbow trout fixed with 50% glutaraldehyde revealed the presence of microridges on surfaces of epithelial cells of the secondary lamellae. These microridges vary in length from 1 to 7 microns, with a mean height of 0.75 microns. Calculations show that they increase the total lamellar epithelial surface area approximately 2.5 fold. Mucus secreting cells are present on the body of the filament and on secondary lamellae. Chloride cells are located primarily in the interlamellae filamental epithelium and on the basal area of lamellae. Extensions of the chloride cell epithelium are microvillous in nature and their height is only slightly greater than that of the microridges of typical lamellar epithelial cells. A reduction in number of complete absence of microvilli on chloride cells appeared to be related to degenerative changes in these cells observed in transmission electron micrographs. Non secretory interlamellae filamental epithelial cells have microridges of very attenuated lengths.

18157. Schindler, D. W., J. Kalff, H. E. Welch, G. J. Brunskill, H. Kling, and N. Kritsch (Dept. of the Environ., Fish. and Mar. Serv., Freshwater Inst., Winnipeg, Manitoba R3T 2N6, Canada). 1974. EUTROPHICATION IN THE HIGH ARCTIC - MERETTA LAKE, CORNWALLIS ISLAND (75° N LAT.). J. Fish. Res. Board Canada, 31(5): 647-662.

Sewage from the Department of Transport Airport Base at Resolute Bay has caused increases in phytoplankton standing crop, changes in algal species composition, oxygen depletion, and disappearance of *Limnocalanus* in Meretta Lake. The annual cycles of chemical and physical events associated with these changes are described. Minimum annual input of phosphorus to Meretta Lake was 0.24-0.29 g/m² of lake surface per year in 1971, with 66-80% supplied by sewage. Nitrogen input was 0.55-0.78 g/m² during the same year, with 41 to 58% from sewage. Results show that severe eutrophication problems may be expected to develop in response to high nutrient inputs, even at arctic latitudes. Arctic lakes, which are sealed under ice for several months of the year, appear to be particularly vulnerable to increased oxygen depletion which accompanies eutrophication. (Authors)

18158. Moyle, Peter B., Stephen B. Mathews, Noel Bonderson (Dept. of Animal Physiol., Univ. of Calif., Davis, California 95616). 1974. FEEDING HABITS OF THE SACRAMENTO PERCH, *Archoplites interruptus*. Trans. Amer. Fish. Soc., 103(2): 399-402.

Examination of 510 stomachs of Sacramento perch from five localities showed that they feed primarily by picking insect larvae and snails from the bottom and aquatic plants or by capturing zooplankton, fish, or emerging insects in midwater. The diet varies with season and size of fish but no daily feeding rhythms were found. Similarity of their diet to that of bluegill indicates that Sacramento perch may have been eliminated from their native habitat through competitive interactions with bluegill. (Authors)

18159. Weisbart, Melvin, and Daniel Feiner (Dept. of Biol., Wayne State Univ., Detroit, Michigan 48202). 1974. SUBLETHAL EFFECT OF DDT ON OSMOTIC AND IONIC REGULATION BY THE GOLDFISH Carassius auratus. Can. J. Zool., 52(6): 739-744.

Goldfish treated with up to 35 parts per billion (ppb), 1, 1, 1-trichloro-2, 2-bis (p-chlorophenyl) ethane (DDT) for up to 330 h in a running freshwater system showed significant but inconsistent decreases in plasma osmotic and sodium concentrations and a significant but inconsistent increase in potassium concentrations. Goldfish exposed to 17.5 ppb DDT for 330 h and subsequently transferred to brackish water (synthetic) showed no significant differences in plasma electrolytes from solvent-treated goldfish. No correlation between pesticide concentrations and total lipid content of individual goldfish was found but for one exception. Fish exposed to higher doses showed higher pesticide levels in their bodies. The lack of correlation between in vitro and in vivo experiments is discussed. (Authors)

18160. Stalnaker, C. B., and R. E. Gresswell (Dept. of Wildl. Sci., Utah State Univ., Logan, Utah 84322). 1974. EARLY LIFE HISTORY AND FEEDING OF YOUNG MOUNTAIN WHITEFISH. Environ. Protection Agency, Ecological Res. Series Report EPA-660/3-73-019, 46 p.; Selected Water Resources Abstracts, 7(17): p. 52, 1974.

Early life history studies and development of culture methods of the mountain whitefish (Prosopium williamsoni) were conducted in the Logan River, and in the Utah State Research Laboratory and USU Fisheries Laboratory. Spawning was observed in the laboratory and in the Logan River from mid-November to mid-December during dusk. At ambient river temperature from 1.7-6.1 C eggs began hatching after 79 days and continued for 23 days. Total mortality to hatch of eggs from weekly collections from five areas was 92%. In the laboratory, at 7.2 C eggs began hatching in 52 days and continued for 23 days; at 8.9 C in 45 days and continued for 30 days. Larval whitefish from two areas showed differences in growth due to temperature experience. Growth was examined in the laboratory at 6, 9, and 12 C. A simple linear model for predicting growth was developed. Whitefish began feeding when 14-15 cm long, and fed near the bottom mainly on Chironomid larvae. Larval whitefish were raised at 2-14 C at 2 degree intervals, and were fed dry trout feed, Oregon Moist Pellets, mosquito larvae, and brine shrimp. Starved fish died earlier at higher temperatures; mortality ranged from 15% for 3 months on brine shrimp to 98% in 1.5 months on Oregon Moist Pellets.

18161. Sissenwine, Michael P., and Saul B. Saila (Mar. Exp. Sta., Graduate School of Oceanogr., Univ. of Rhode Island, Kingston, Rhode Island 02881). 1974. RHODE ISLAND SOUND DREDGE SPOIL DISPOSAL AND TRENDS IN THE FLOATING TRAP FISHERY. Trans. Amer. Fish. Soc., 103(3): 498-506.

The available data was evaluated to assess the impact of the Rhode Island Sound dredge spoil disposal area on the floating trap fishery. It is unlikely that a significant portion of the observed decline in landings has resulted from a decrease in fishing effort since no significant correlation was established between these variables. The mean levels of landings were not significantly different when comparisons were made between the period before the onset of dumping and the short post-dumping period. A review of other fisheries for scup (Stenotomus chrysops), the predominant species caught by Rhode Island floating traps, indicated that landings have declined throughout the species' range. (Authors)

18162. Gardiner, W. Ross (Freshwater Fisheries Lab., Pitlochry, Perthshire, Scotland). 1974. AN ELECTROPHORETIC METHOD FOR DISTINGUISHING THE YOUNG FRY OF SALMON Salmo salar (L.) FROM THOSE OF TROUT Salmo trutta (L.). J. Fish Biol., 6(4): 517-519.

Young fry of salmon were distinguished from those of trout using electrophoresis of whole fry extracts on cellulose acetate sheets. The separation patterns were revealed by general protein staining. The method was found helpful in resolving the mixed salmon and trout fry of an upland stream. (Auth.)

18163. Sand, Olav (Inst. of Zoophysiol., Univ. of Oslo, Oslo, Norway). 1974. DIRECTIONAL SENSITIVITY OF MICROPHONIC POTENTIALS FROM THE PERCH EAR. J. Exp. Biol., 60(3): 881-899.

Microphonic potentials were recorded from the lagena and from different parts of the sacculus in the perch during horizontal and vertical vibration of the fish in air. The lagena was predominantly sensitive to vertical vibrations, whereas the anterior part of the sacculus was equally sensitive to vertical and horizontal vibrations. The amplitude of the saccular microphonic potentials evoked by horizontal vibrations was a function of the vibration direction. Sound-induced pulsations radiating from the swimbladder will be efficient in evoking saccular microphonic potentials. The relative effect in evoking microphonic potentials of vertical compared to horizontal vibrations was frequency dependent, and it is concluded that the pattern of otolith movements during sound stimulation may also change with frequency. This phenomenon constitutes a possible basis for peripheral frequency analysis in fish.

18164. FAO of the UN (Rome, Italy). 1974. THE SCIENTIFIC ADVISORY FUNCTION IN INTERNATIONAL FISHERY MANAGEMENT AND DEVELOPMENT BODIES. Supplement 1 to the Report of the 7th session of the Advisory Committee on Marine Resources Research, FAO Fisheries Reports No. 142, Suppl. 1, 14 p.

18165. Ryder, R. A., S. R. Kerr, K. H. Loftus, and H. A. Regier (Min. of Nat. Res., Fish and Wildl. Res. Branch, Thunder Bay, Ontario, Canada). 1974. THE MORPHOEDAPHIC INDEX, A FISH YIELD ESTIMATOR - REVIEW AND EVALUATION. J. Fish Res. Board Can., 31(5): 663-688.

The morphoedaphic index (MEI), a fish yield estimator, was historically reviewed and evaluated. Background papers leading to the development of the MEI were discussed, as well as more recent advances. The MEI was defined and its criteria for use examined. The significance of its components - total dissolved solids and mean depth - were explained. The MEI was compared with related models developed by other workers. The global range of the MEI was outlined as well as restrictions on its use. Sustained fish yields at different MEI values for various climatic regions were predicted. Several special applications of the MEI were described, including: prediction of angling yield in north-temperate lakes; prediction of commercial fish yield on a newly created reservoir; indicator of ecological stresses and changing environments; and contrasting responses to cultural eutrophication in the littoral and profundal zones of lakes. The implications of the MEI for ecological theory were explored, and its potential for future application in management was outlined. (Authors)

18166. Jackson, William Dale, and George L. Harp (Div. of Biol. Sciences, Ark. State Univ., State University, Arkansas 72467). 1973. ICHTHYOFAUNAL DIVERSIFICATION AND DISTRIBUTION IN AN OZARK STREAM IN NORTH-CENTRAL ARKANSAS. Proc. of Ark. Acad. of Science, Vol. 27, pp. 42-46.

The distribution and diversity of the ichthyofauna of Arkansas are poorly known. This study is part of a continuing effort to elucidate the natural history of Arkansas. Big Creek is a relatively small, clear, cool-water stream in the Ozark Plateau of northcentral Arkansas. Big Creek and its tributaries drain into Lake Norfolk, an impoundment on North Fork River. A total of 6,779 fish of 30 species was collected. Dominant pool species included *Notropis boops*, *Fundulus catenatus*, *F. olivaceus*, *Labidesthes sicculus*, and *Campostoma anomalum*; dominant riffle species included *Etheostoma spectabile*, *E. caeruleum*, *Notropis boops*, *Fundulus catenatus*, and *Campostoma anomalum*. The numerical standing crop ranged from 1.3 to 2.6 fish/m² in the pools and riffles, respectively. The relative uniformity of substrate and soil types throughout the watershed, and the absence of rooted aquatic plants, limited the diversity of species found. The concomitant reduction in competition and predation probably explains the relatively large numerical standing crop. (Authors)

18167. Hunn, Joseph B., and John L. Allen (Fish Control Lab., La Crosse, Wisconsin 54601). 1974. MOVEMENT OF DRUGS ACROSS THE GILLS OF FISHES. Reprint: Annual Review of Pharmacology, Vol. 14, pp. 47-55.

Attempt is made to use data on toxicity, efficacy, and residues of three chemicals - a weak base (MS-222), a base (quinaldine), and an acid (TFM) - to show that both lipid solubility and degree of ionization play a significant role in the movement of these compounds across the gills of fishes. (From Authors' Introduction)

18168. Burton, Dennis T., and Charles J. Moore (Acad. of Nat. Sci. of Phila., Benedict Estuarine Lab., Benedict, Maryland 20612). 1974. VENTILATION FREQUENCY CHANGES IN THREE ESTUARINE FISH EXPOSED TO A 5°C INCREASE AT ACCLIMATION TEMPERATURES OF 5°, 15° AND 25°C. Reprint: The ASB Bulletin, 21(2): p. 44.

This study compares the ventilation frequency responses of Trinectes maculatus (hogchoker), Morone americana (white perch) and Leiostomus xanthurus (spot) acclimated to 5°, 15° and 25°C and exposed to a 5°C thermal increase. Ventilation frequencies were recorded for 5-minute periods at half-hour intervals for 16 hours before water temperatures were increased 5°C over a 15-minute period. Five-minute recordings at half-hour intervals were continued for 24 hours at the elevated temperatures. In general, ventilation rates increased concurrently in all species as temperatures were increased. Ventilation quickly stabilized at the higher rates and remained relatively constant throughout the 24 hours in all acclimation groups. The mean ventilation rate $\cdot \text{minute}^{-1}$ for 5°C acclimated T. maculatus before the 5°C increase was 9 vs. 20 after the 5°C increase ($P < 0.005$); 38 before vs. 48 after ($P < 0.025$) in 15°C hogchokers and 74 vs. 88 ($P < 0.005$) in 25°C hogchokers. Five degree acclimated M. americana had mean ventilation rates $\cdot \text{minute}^{-1}$ of 26 before vs. 36 after the 5°C increase ($P < 0.001$); 46 before vs. 64 after ($P < 0.025$) in 15°C perch and 82 vs. 105 ($P < 0.100$) in 25°C perch. The average ventilation rate $\cdot \text{minute}^{-1}$ for 5°C acclimated L. xanthurus was 28 before vs. 32 after the 5°C increase ($P < 0.050$); 25 before vs. 36 after ($P < 0.005$) in 15°C spot and 45 vs. 66 ($P < 0.025$) in 25°C spot. Interspecific differences in ventilation rates were found at each acclimation temperature, as well as interspecific differences in response to the elevated temperature at each acclimation temperature. (Authors)

18169. FAO of the United Nations (Rome, Italy). 1974. FAO AQUACULTURE BULLETIN. A QUARTERLY NEWS DIGEST OF AQUACULTURE RESEARCH AND DEVELOPMENT. FAO Aquacult. Bull., 6(2-3): 36 p., illus.

Text includes: From research institutions ... Antagonist factors in carp pituitary - Artificial propagation of Sardinella - Domestic strains of channel catfish - Feeding of larval shrimp - Shrimp culture experiments in Tahiti - Culture of Panaeus duorarum in Nigeria - Experimental culture of penaeid shrimps in India - Feed conversion ratios in commercial fish culture in Israel - Sludge as a feed additive - Preparation of pelleted trout feed in Brazil - Use of cheap proteins in fish feeds - Mass culture of Chlorella - Chemical selection of zooplankton in rearing ponds - Benthic feeding of common carp - Nile perch as a predator in tilapia ponds - Intensive carp culture in Poland - Monoculture of grey mullet - Intensive polyculture of carps in India - Oyster culture in Venezuela - Culture of Chrysichthys - Pond culture of tambaqui - Pond culture of pirapitinga - Air guns for controlling summer mortalities in fish ponds - Substitutes for Derris powder - Wind effect on pond water circulation - Bund protection against erosion. Aquaculture development ... Afghanistan - Brazil - Canada - French Polynesia - Hungary - India - New Caledonia - Norway - Philippines - Turkey - United Kingdom - United States. Fish diseases and their control ... Immunization techniques - Transmission of IHN virus and its control - Occurrence of IHN in eastern North America - Control of whirling disease - Use of formalin to control fungal infection - Improved method for whirling disease detection - Whirling disease in New Zealand - Carp erythrodermatitis - Fish diseases in Spain - Tumorous growths in fishes - Fish disease diagnostic service - Postgraduate course in aquatic veterinary science. (From contents)

18170. Bruley, George K., and Emmitt McClendon (Inland Fish. Br., Dept. of Fish and Game, Sacramento, California 95819). 1974. CALIFORNIA TROUT, SALMON, AND WARMWATER FISH PRODUCTION AND COSTS, 1972-73. Inland Fish. Admin. Report No. 74-2, 38 p., Calif. Dept. of Fish and Game; NOAA Marine Fisheries Abstracts, 27(7): 25.

This report is a summary of the activities of the fish hatcheries in the fiscal year 1972-73. In that time over 55 million fish weighing over 4 million pounds were planted. The species of fish produced are listed under three major classes: resident fish, anadromous fish, and warmwater fish. The resident fish include six species of trout, the Arctic grayling, and kokanee. The anadromous fish produced include king salmon, silver salmon, and steelhead trout. The warmwater fish produced include crappie, bluegill, catfish, the basses, threadfin shad, perch, and others. Catchable-size fish accounted for 77% of the total weight produced. Fingerling fish are those up to 1 oz. each; subcatchable fish are from 1 oz each to six fish per pound in size; catchable fish are six fish per pound and larger; and brood fish averaged about 1 lb each. The total weight of resident fish produced in the year decreased by about 300 thousand pounds but the number of these fish increased by about 1.4 million fish. Subcatchable and catchable-sized fish production decreased both in weight and numbers. Rainbow trout accounted for 70% of the total weight of fish produced in the hatcheries. Almost 30 million anadromous fish were produced; of these, over 24 million were fingerlings.

18171. International North Pacific Fisheries Commission. 1974. ADDITIONAL INFORMATION ON THE EXPLOITATION, SCIENTIFIC INVESTIGATION, AND MANAGEMENT OF SALMON STOCKS ON THE PACIFIC COASTS OF CANADA AND THE UNITED STATES IN RELATION TO THE ABSTENTION PROVISIONS OF THE NORTH PACIFIC FISHERIES CONVENTION. Int. No. Pacific Fish. Comm. Bull. No. 29, 178 p.

18172. Tarby, Martin J. (Dept. of Nat. Res., Cornell Univ., Ithaca, New York 14850). 1974. CHARACTERISTICS OF YELLOW PERCH CANNIBALISM IN ONEIDA LAKE AND THE RELATION TO FIRST YEAR SURVIVAL. Trans. Amer. Fish. Soc., 103(3): 462-471.

Because adult yellow perch were known to be cannibalistic in Oneida Lake, New York, this species was studied in 1965-71 to identify factors affecting the intensity of cannibalism and to evaluate the effect of cannibalism on the abundance of young perch. Adult perch changed their food habits in response to changes in the availability of different food items from June through September. Although young-of-the-year perch were most abundant in adult stomachs in August of most years, wide variations occurred in the annual intensity of cannibalism. Length and abundance of young perch, abundance of large chironomids and amphipods, and the size of the adult predator were identified as important factors for explaining variations in the frequency of occurrence of young perch in stomachs of adults. Correlations between the annual intensity of perch cannibalism and length and abundance of young perch imply that cannibalism operates as a compensatory or possibly an extra-pensatory mortality process. The consumption of young perch by adults in 1971 was estimated from the incidence of young perch in stomachs, the rate of food evacuation, and the size of the adult perch population. About 25% of the perch fry that were available as forage in early June succumbed to cannibalism in June-September. This level of consumption of young perch by adults in a year of intense cannibalism, together with evidence that perch cannibalism likely does not operate in a manner consistent with the observed depensatory mortality of young perch, imply that cannibalism was not decisive in limiting the strength of year classes in 1965-71. (Auth.)

18173. Carpenter, Stanley J., and Henry L. Heyl (Dept. of Anatomy, Dartmouth Medical School, Hanover, New Hampshire 03755). 1974. FINE STRUCTURE OF THE CORPUSCLES OF STANNIUS OF ATLANTIC SALMON DURING THE FRESH-WATER SPAWNING JOURNEY. Gen. Comp. Endocrinol., 23(2): 212-223.

18174. Boyce, F. M. (Dept. of the Environ., Water Mgmt Serv., Lakes Res. Div., Canada Centre for Inland Waters, Burlington, Ontario L7R 4A6, Canada). 1974. SOME ASPECTS OF GREAT LAKES PHYSICS OF IMPORTANCE TO BIOLOGICAL AND CHEMICAL PROCESSES. J. Fish. Res. Board Can., 31(5): 689-730.

This is a discussion of some aspects of the physical behavior of the Great Lakes written for scientists with backgrounds in disciplines other than physics. The basic physical characteristics of Great Lakes basins are summarized. These characteristics are determined by the facts that (i) the basins are closed, (ii) the basins are large enough so that the Coriolis force is an important component of their dynamics, (iii) the principal source of mechanical energy is the wind, and (iv) the basins are vertically stratified in summer. Discussion of large-scale horizontal motions includes both currents and diffusion. The advection-diffusion equation is used as a framework for a discussion which includes a summary of the basic problem confronting hydrodynamic modellers, the parameterization of turbulence phenomena in terms of mean flow variables. Vertical transfer processes are considered, notably the measurement of vertical fluxes of heat and momentum and the computation of eddy diffusion coefficients, the prediction of thermal structure in terms of net surface wind stresses and heat fluxes, and the interactions of waves, currents, and turbulence in the thermocline. The dynamical structure of the coastal zone is outlined, and the review concludes with recommendations for future work on the understanding of vertical turbulent transports, the climatology of Great Lakes coastal zones, and an operational approach to verifying and improving numerical models of lake circulation. (Auth.)

18175. Dorson, M., and P. de Kinkelin (Lab. d'Ichtyopathologie, I.N.R.A., Thiverval, Grignon, France). 1974. INFECTIOUS PANCREATIC NECROSIS OF SALMONIDS: SEROLOGICAL INVESTIGATION IN DOMESTIC AND WILD POPULATIONS. (Necrose pancreatique infectieuse des salmonides: enquete serologique dans les populations domestiques et sauvages). Recherches Veterinaires, in press; Fish Health News, 3(3): p. 6.

Wild and hatchery stocks of French salmonids were tested for serum neutralizing activity against the Sp serotype of infectious pancreatic necrosis virus. Wild brown trout were the only fish found devoid of neutralizing activity. Neutralizing activity was found in all other fish: hatchery rainbow, brown and brook trout. Serum from IPN virus carriers exhibited a noticeable activity, as did serum of rainbow trout from IPN-free farms. The nature and origin of the neutralizing factor are unknown, but preliminary characterization indicates that it derives from an immune response. -- Ken Wolf

18176. Williams, R., and M. F. Harcup (Dept. of Applied Biol., Univ. of Wales Inst. of Sci. & Technology, Cathays Park, Cardiff, Wales). 1974. THE FISH POPULATIONS OF AN INDUSTRIAL RIVER IN SOUTH WALES. J. Fish Biol., 6(4): 395-414.

The River Sirhowy, a trout river of the Ebbw System in south-east Wales still subject to sporadically high levels of suspended solids derived from the coal mining industry, was investigated over a three year period to assess its importance in the recolonization of a fishless river, the Ebbw Fawr, which is expected to recover from the effects of steelworks effluents discharged near its headwaters. Eight species of fish were recorded. Spawning areas for brown trout (*Salmo trutta* L.) were limited by industrial and urban developments and the discharge of suspended solids. Small numbers of native trout were produced in the system and the growth of these fish was poor in the main river, confirming the need for regular stocking. Movements of stocked trout were limited except in the lower reaches of the river where the presence of a native population, high levels of suspended solids and flash floods may have increased the numbers of fish moving into the recovering Ebbw Fawr. (Authors)

18177. FAO of the United Nations (Rome, Italy). 1973. FAO DEPARTMENT OF FISHERIES. LIST OF PUBLICATIONS AND DOCUMENTS, 1948-1973. FAO Fisheries Circular No. 100, Revision 2, 211 p.

18178. Sekavec, Glenn B. (NMFS, Atlantic Estuarine Fish. Center, Beaufort, North Carolina 28516). 1974. SUMMER FOODS, LENGTH-WEIGHT RELATIONSHIP, AND CONDITION FACTOR OF JUVENILE LADYFISH, Elops saurus Linnaeus, FROM LOUISIANA COASTAL STREAMS. Trans. Amer. Fish. Soc., 103(3): 472-476.

A total of 295 juvenile ladyfish Elops saurus Linnaeus were collected with surface trawls from Louisiana coastal streams in June 1968 and June 1969. The fish ranged from 45 to 201 mm in fork length. Of the 295 ladyfish stomachs examined, 229 (77.6%) contained food. Fish constituted 94.5% by occurrence of the food organisms and decapod crustaceans 5.5%. Gulf menhaden comprised 72.0% of the fish identified. The calculated length-weight relationship for juvenile ladyfish in the size range 45-201 mm (fork length) was $\log_{10} W = -5.3295 + 3.1123 \log_{10} L$, and the mean condition coefficient was 8.1. (Auth.)

18179. Bowers, A. B. (Mar. Biol. Sta., Univ. of Liverpool, Port Erin, Isle of Man, United Kingdom). 1974. MARINE FISH CULTURE IN BRITAIN. IX. GROWTH OF CULTURED PLAICE TO MARKETABLE SIZE IN THE LABORATORY. Journal du Conseil, 35(2): 149-157; NOAA Marine Fish. Abstracts, 27(7): p. 25.

Plaice were trawled from coastal waters of the Isle of Man and placed in outdoor seawater ponds. The fish produced fertile eggs and about 20,000 were hatched. The hatchlings were reared to the metamorphosis stage and 100 of these were selected and transferred to an indoor tank. In 3 years they grew to an average length and weight of 23.5 cm and 176 g, respectively. The fish were transferred to a larger tank where several females spawned but the eggs were unfertilized. Throughout their lives the fish were exposed to 12 h per day of fluorescent lighting. Thirty-eight of these fish were transferred to another tank where only natural light illuminated the area. The females in this group spawned; the eggs were removed and incubated at 7° - 8°C. Most of the eggs hatched, and a few days later, the larvae were fed nauplii of Artemia salina. Of 2,000 eggs hatched, 954 fish survived and this group was observed for this report. The fish were divided into three groups, one containing 50 fish, one with 250 fish, and the third with 654 fish. Over an 8-mo period, mortality in the tank stocked with 654 fish was 88%; in the 250-fish tank, 83%; and in the 50-fish tank, 66%. When the fish were 11 mo old they were weighed and measured. Fish 150 mm or more were separated from the other fish and placed in a tank; other fish 100-149 mm in length were placed in another tank; and the remaining fish were discarded.

18180. Höglund, Lars B., and Mats Åstrand (Inst. of Zoophysiol., Univ. of Uppsala, Sweden). 1973. PREFERENCES AMONG JUVENILE CHAR (Salvelinus alpinus L.) TO INTRASPECIFIC ODOURS AND WATER CURRENTS STUDIED WITH THE FLUVIARIUM TECHNIQUE. Inst. of Freshwater Research, Drottningholm Report No. 53, pp. 21-30.

The role of olfaction for communication and schooling behaviour among juvenile char (Salvelinus alpinus (L.)) was investigated. Intact fishes showed a strong preference to water currents with intraspecific odours in a choice between one free from smell. The effect disappeared when the olfactory organ was removed although the normal preference to water currents seemed unchanged. The results indicate that olfaction and chemical stimulation play a dominant role in communication (attraction) between individual young char (S. alpinus (L.)). Authors' summ.

18181. Norris, Logan A., and Richard A. Miller (Pacific NW Forest and Range Exp. Sta., Forest Serv., USDA, Corvallis, Oregon 97331). 1974. THE TOXICITY OF 2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN (TCDD) IN GUPPIES (Poecilia reticulatus Peters). Bull. Environ. Contamin. Toxicol., 12(1): 76-80.

Exposure of guppies to 0.1, 1.0, or 10.0 ppb TCDD for 120 hours caused complete mortality in the next 32, 21, and 30 days, respectively. Duration of survival was significantly and positively correlated with body length. The concentrations of TCDD used in these tests were considerably greater than expected to occur in forest streams after aerial application of 2,4,5-T. The threshold-response level for TCDD in fish has not been reported. (Authors' summ.)

18182. Cook, David G., and Murray G. Johnson (Dept. of the Environ., Fish. and Mar. Serv., Great Lakes Biolimnol. Lab., Canada Centre for Inland Waters, Burlington, Ontario L47 4A6, Canada). 1974. BENTHIC MACROINVERTEBRATES OF THE ST. LAWRENCE GREAT LAKES. J. Fish. Res. Board Can., 31(5): 763-782.

The history of Great Lakes benthic research from 1870 to the present is briefly reviewed. An examination of the status of taxonomic work on benthic components, and a consideration of the zoogeographical history of the benthos leads to a discussion of bottom communities and macroinvertebrate production in the five major lakes. Profundal communities throughout the lakes are dominated by the glaciomarine relict amphipod Pontoporeia affinis and various species of Oligochaeta, Sphaeriidae, and Chironomidae. The specific composition of these components, and natural and recently imposed changes in their proportions within communities are examined. Population densities and standing stocks, and the proportion of oligochaetes in communities, all tend to increase in response to a natural gradient in productivity inferred from increasing concentrations of parameters such as organic matter and water hardness. Man's influence on water quality anywhere along this gradient compounds the effects of natural factors towards tubificid communities of predictable species composition: Limnodrilus hoffmeisteri, L. claparedeianus, L. cervix, L. manumeensis, Pelosclex multisetosus, and often Tubifex tubifex. The ameliorating influence of water depth is shown in Lake Erie where the change in community composition reflects improving profundal water quality from west to east - a reversed model of the Great Lakes system as a whole. (Authors)

18183. Dryden, R. L., and C. S. Jessop. 1974. IMPACT ANALYSIS OF THE DEMPSTER HIGHWAY CULVERT ON THE PHYSICAL ENVIRONMENT AND FISH RESOURCES OF FROG CREEK. Environ. Canada, Res. Mgmt Branch, Central Region Technical Report Series No: CEN/T-74-5, 59 p.

The impact of improper culvert design and effects on the hydrology and fish biology of Frog Creek, N.W.T. are discussed. Fish migration discharge design, as required by Fisheries and Marine Service, Environment Canada for northern highway culverts, is defined. At this or lower discharges, flow conditions within the culvert must allow for the upstream passage of fish. Fish migration discharge for Frog Creek, N.W.T. is calculated as $22.4 \text{ m}^3/\text{s}$ (800 cfs). If the culvert at Frog Creek has been designed to allow fish passage at this discharge, the delay to fish migrations would have been only 3 to 4 days. Water velocities in the Frog Creek culvert during 1973 exceeded the maximum allowable velocity of 1.5 m/s (5 fps) for 40 days from May 26 to July 5. Bank erosion downstream from the culvert caused retreat of the river bank at a rate of 15 cm (6 inches) per day. Siltation of the stream resulting from construction was evident, but appeared to be insignificant. During the peak discharge period, extensive ponding occurred upstream of the culvert. Ice buildup inside the culvert occurred primarily during early spring as a result of over-ice flow. High water velocities within the culvert blocked the spawning migration of approximately 600 northern pike Esox lucius (Linnaeus) and appeared to block movements of some broad whitefish Coregonus nasus (Pallas). Fish passage did not become generally possible until July 5, when water velocities of less than 1.5 m/s (5 fps) were attained. After passage became possible, both pike and broad whitefish dispersed equally in upstream and downstream directions. It was estimated that only a small proportion of the total pike population of the Frog Creek drainage was blocked by the culvert. No physiological effects of culvert delay on ripe pike were evident. Feeding habits of northern pike and broad whitefish are described in relation to available food organisms, as indicated by drift and artificial substrate samples. Age and growth and length frequency distributions for pike and broad whitefish are described. Maximum ages recorded in Frog Creek were 8 years for pike and 6 years for broad whitefish. (Authors)

18184. Pagenkopf, Gordon K., and Dennis R. Neuman (Dept. of Chem., Montana State Univ., Bozeman, Montana 59715. 1974. LEAD CONCENTRATIONS IN NATIVE TROUT. Bull. Environ. Contamin. Toxicol., 12(1): 70-75.

18185. Taube, Clarence M. 1974. DISAPPEARANCE OF DEAD FISH AND ASSESSMENT OF MORTALITY. Mich. Dept. of Nat. Res., Fish. Div., Fish. Research Report No. 1812, 12 p.

Assessing the loss of fish that results from a sudden, extensive kill in a lake or stream usually is a difficult task. The estimate probably seldom approximates the actual number, and it is apt to be low. Disappearance of many of the victims is often responsible for much of the difficulty. Concealment by water depth is one of the main causes of disappearance. Adult coho salmon that were introduced into a 1.4-mile stretch of the Platte River in Benzie County afforded a test of how completely the introduced salmon could be recovered after they had spawned and died. Twelve hundred coho were released here each fall in three successive years. After the fish began to die, the stream was patrolled to search for carcasses, at least once every 7 days and until spawning activity had ceased. Despite good conditions for retrieval (clear water, mostly shallow depths, large size of the fish), less than 50% of the salmon were found each year. Evidently, the bulk of those not found were hidden in restricted areas of deep water and beneath cover. Better methods are needed for evaluating fish mortalities. The potentiality for developing such techniques appears to be good. Several approaches are suggested. (Auth.)

18186. Ghittino, Pietro, Frederick G. Smith, and John S. Glenn ((Dept. of Med. Microbiol., College of Vet. Med., Univ. of Georgia, Athens, Georgia 30602). 1974. A CASE REPORT OF MYXOSPORIDIA (Myxidium giardi) IN THE DERMIS OF AN AMERICAN EEL (Anguilla rostrata). Riv. It. Piscic. Ittiop., 9(1): 13-17.

The authors describe a case of myxosporidial parasitism in an American eel (Anguilla rostrata). The affected eel had extensive areas of skin which were light gray in color and slightly elevated above the surrounding tissue and had a few small cysts on the gills. Histologic sections of the skin revealed numerous ovoid cysts (300-750 μ) in the stratum compactum of the dermis. The overlying epidermis was frequently hyperplastic, with button-like growths. No gross or microscopic lesions were observed in the muscle tissue or viscera. The spores, observed within cysts or free in smears, appeared fusiform and symmetrical with an enlarged central area, typical of members of the genus Myxidium. The sutural line was straight and a sutural ridge was visible. Each valve of the spore had 9-11 stria and contained two polar capsules. Polar filaments when visible were 70 μ long. The spore length was 10-12 μ , the diameter 4-6 μ and the polar capsules were 2-3 μ in diameter. The authors discuss the myxidia already described as eel parasites and conclude that the Myxidium species in question is M. giardi, resulting in a new tissue tropism and host for this parasite. (Authors)

18187. Anderson, Dennis. 1974. A BIOLOGICAL TRICKLING FILTER SYSTEM FOR WATER REUSE IN TROUT REARING. Minnesota Dept. of Nat. Res., Div. of Fish and Wildl., Investigational Report No. 322, 26 p.

A biological trickling filter was constructed and tested in a 95% water reuse trout rearing system. The filter was capable of removing ammonia from fish raceway effluent at a maximum rate of 6.4×10^{-5} pounds of $\text{NH}_3\text{-N}$ per square foot of media surface, which was the equivalent of removing the ammonia output from one pound of high protein trout food by 475 square feet of filter media. At 95% water reuse levels, all fish rearing water quality parameters including temperature, oxygen and ammonia were maintained at satisfactory levels. Waste water from the 95% water reuse system was generally within water quality standards for hatchery effluent. Water temperatures in the system could be regulated by the amount of make up water used to vary growth rates and feeding rates of trout to meet specific requirements. The trickling filter provides an economical and satisfactory method of extending existing water supplies and improving water quality. (Auth.)

18188. Eschmeyer, Paul H., and Van T. Harris (Editors). 1974. BIBLIOGRAPHY OF RESEARCH PUBLICATIONS OF THE U. S. BUREAU OF SPORT FISHERIES AND WILDLIFE, 1928-72. U. S. Dept. of the Interior, Bur. of Sport Fish. & Wildl., Resource Publication 120, 154 p.

18189. Milbrink, Göran (Inst. of Freshwater Res., Drottningholm, Sweden). 1973. ON THE VERTICAL DISTRIBUTION OF OLIGOCHAETES IN LAKE SEDIMENTS. Inst. of Freshwater Research, Drottningholm, Report No. 53, pp. 34-50.

The microstratification technique presented here primarily seems to have confirmed some general ideas as to where various bottom invertebrates dwell in relation to the mud-water interface. Naidid oligochaetes were concentrated at the interface, i.e. rarely below a mud depth of 2-4 cm. It seems quite clear that most naids are more or less bound to the mud surface - or to submersed vegetation (which was not studied here). On the whole, tubificids penetrated considerably deeper than naids, even to depths of about 15 cm in the mud, but with maxima of concentration between two and four cm. Some tubificid species like Limnodrilus hoffmeisteri, Potamothrix hammoniensis, and Potamothrix vejovskyi were with few exceptions, the most deep-penetrating species. Potamothrix heuscheri and Tubifex tubifex were also capable of penetrating deeply, while Aulodrilus pluriset, in particular, but also Bothrioneurum vejovskyanum, Aulodrilus pigueti and some other tubificids displayed as superficial habits as any naids. The former tubificids are well-known deep-burrowers with the adult worms generally penetrating deepest. These deep migratory movements are not necessarily related to feeding. Aulodrilus pluriset often occurs in mud rich in plant fragments which makes it more or less bound to the mud surface. The A. pluriset specimens picked out alive from the sediment chambers of the sampler were all, on each occasion, dwelling in tubes of clay lying on the mud surface reminiscent of the tubes of some chironomid larvae. Bigger specimens of Chironomus plumosus were easily distinguishable from other chironomid larvae in that they were dwelling quite deep in the mud - often down to 15 cm. It is difficult to say if this is a consequence of repulsive movements by the larvae away from the sampler. Most other chironomid larvae were fairly well concentrated to the upper two centimetres of the mud. Pontoporeia affinis was generally found a few centimetres below the mud surface, which is also in good agreement with the author's general experience. Ostracoda and Cladocera were located close to the interface, while Copepoda as a rule were the deepest penetrating organisms. Since the bottom material was sorted alive with no preserving additives there should be no confusion concerning dead organisms in the material. In three surveys out of four Cyclops spp. had their maxima of occurrence at a depth of about ten centimetres in the sediments. Cyclops specimens were quite often found at depths of even about 20 centimetres. Whether they were dormant or not is difficult to say, but they were all quite agile when sorted out. Pisiids were generally found in the top 2 centimetres of the sediments, but they could also be encountered deeper - at about 10 centimetres. (From Auth.'s summ.)

18190. Larimore, R. Weldon (Ill. Nat. History Survey, Urbana, Illinois 61801). 1974. STREAM DRIFT AS AN INDICATION OF WATER QUALITY. Trans. Amer. Fish. Soc., 103(3): 507-517.

Stream drift and benthos were collected from five stream locations having different levels of domestic and industrial pollution. The drift organisms from 100 m³ of water during the diel period of peak drifting was compared with the benthos from 1 m² of stream bottom. Numbers and weights of both drift and benthos followed similar quantitative relations with water quality, generally increasing with water degradation. The relative abundance of benthos greatly exceeded that of the drift at the most polluted station where tubificids, which infrequently drift, were abundant. A greater variety of organisms occurred in the drift than in the benthos. Drifting organisms came from a wider spectrum of habitats and were collected with less effort than benthic organisms but did not always include certain benthic forms that seldom leave the stream bottom. (Auth.)

18191. Griffith, Robert W. (Bingham Lab. and Dept. of Biol., Yale Univ., New Haven, Connecticut 06520). 1974. PITUITARY CONTROL OF ADAPTATION TO FRESH WATER IN THE TELEOST GENUS Fundulus. The Biological Bull., 146(3): 357-376.

18192. FAO of the UN (Rome, Italy). 1974. DIRECTORY OF INSTITUTIONS ENGAGED IN POLLUTION INVESTIGATIONS. CONTAMINANTS IN AQUATIC ORGANISMS. FAO Fish. Circular No. 325, Rev. 1, 43 p. (Distribution restricted).

18193. Payne, R. H. (Dept. of the Environ., Fish. & Mar. Serv., Biol. Sta., St. John's, Newfoundland, Canada). 1974. TRANSFERRIN VARIATION IN NORTH AMERICAN POPULATIONS OF THE ATLANTIC SALMON, Salmo salar. J. Fish. Res. Board Can., 31(6): 1037-1041.

A latitudinal cline was indicated by the frequency of the Tf₄ transferrin allele in North American populations of the Atlantic salmon (Salmo salar) and an earlier suggestion of a major genetic discontinuity between the salmon populations of Newfoundland and those of the Canadian Maritimes is rejected. Male one-sea-winter fish had a statistically significant deficit of heterozygotes but transferrin phenotypes of one-sea-winter females and two-sea-winter or older fish of either sex agreed closely with the predictions of Hardy-Weinberg-Castle equilibria. Heterozygosity for Tf₄ may be semilethal in male salmon programmed to return to spawn after one winter at sea. A comparison of anadromous and nonanadromous salmon populations from the same river system demonstrated that considerable genetic divergence can take place when postglacial crustal recovery produces barriers to upstream migration. The relative fitnesses of the transferrin phenotypes may be different for anadromous and nonanadromous life styles. In view of the demonstrated genetic divergence between anadromous and nonanadromous salmon stocks, the practice of "improving" salmon rivers by removing natural obstructions to upstream migration must be reconsidered in the case of river systems which have large stocks of nonanadromous salmon. (Auth.)

18194. Greenland, Donald C., and Robert L. Gill (U.S. Fish & Wildl. Service, Fish Farming Development Center, Rohwer, Arkansas 71666). 1974. A DIVERSION SCREEN FOR GRADING POND-RAISED CHANNEL CATFISH. Prog. Fish-Cult., 36(2): 78-79.

A diversion screen of woven wire installed around a demand feeder was tested as a device for selectively grading pond-raised channel catfish (Ictalurus punctatus) into two size groups. Small fish able to negotiate the 2-in. (5.08 cm) mesh were concentrated inside the diversion screen. Larger fish excluded by the wire barrier were diverted to a nearby unscreened feeder. Samples of fish taken at the two locations showed that fish captured at the screened feeder were significantly smaller. (Authors)

18195. Smith, Charlie E., and Warren G. Williams (U.S. Fish & Wildl. Service, Fish Cultural Development Center, Bozeman, Montana 59715). 1974. EXPERIMENTAL NITRITE TOXICITY IN RAINBOW TROUT AND CHINOOK SALMON. Trans. Amer. Fish. Soc., 103(2): 389-390.

Two groups of 20 yearling rainbow trout were exposed continuously to inflowing water containing 0.15 and 0.55 mg/liter nitrite as nitrite nitrogen (NO₂-N), for 48 and 24 hr, respectively. Both groups developed methemoglobinemia but mortality occurred only at the highest concentration (55%). Salmon exposed to 0.50 mg/liter NO₂-N for 24 hr developed methemoglobinemia and suffered a 40% mortality. Fingerling trout were less sensitive to nitrite than yearlings. (Authors)

18196. Ito, Yasuyuki, and Toshiro Murata (Women's Coll., Tokai Univ., Miyamae-cho, Shizuoka, Japan). 1974. STUDIES ON THE INFLUENCE OF PCB ON AQUATIC ORGANISMS - IV. CHANGES IN SERUM LIPID CONTENTS AND FORMATION OF LIPID PEROXIDE IN THE TISSUES OF CARP ADMINISTERED WITH PCB ORALLY. Bull. Jap. Soc. Sci. Fish., 40(3): 261-265. In Japanese with English figs. and tables.

Changes in the levels of several serum lipid components and the formation of lipid peroxides in hepatopancreas, kidney and the dark muscle of carp, Cyprinus carpio, fed with a diet containing PCB (Aroclor 1248) at 250 ppm were examined. After feeding with the PCB-containing diets for 7, 14 or 21 days, the carps were sacrificed for chemical analyses. Triglyceride, total cholesterol, free cholesterol and free fatty acid contents were increased, while the ester to total cholesterol ratio was decreased in the PCB fed group. Especially, the triglyceride levels in carps fed with PCB showed substantial increases, more than 30%, compared with those of the control fishes. The thiobarbituric acid reactive compounds were shown to increase in the hepatopancreas and the dark muscle with the administered

dosage of PCB. In the difference spectrum of hepatopancreal lipid, the diene conjugation absorption appeared after feeding for 14 days. Furthermore, the lipid metabolism in carp fed with the diet containing PCB is discussed, indicating the possibility of lipid peroxide formation in subcellular membranes. (Authors)

18197. Harp, George L., and Ronald D. Hubbard (Div. of Biol. Sci., Arkansas State Univ., State University, Arkansas 72467). 1972. LIMNOLOGY OF FOUR BAUXITE OPEN-PIT LAKES. Arkansas Acad. Sci. Proc., 26: 47-51.

The aquatic flora and fauna and 18 physicochemical characteristics of four bauxite open-pit lakes were studied from September 1969 to August 1970. The least acid lake (pH 3.4-4.4) supported 49 different aquatic insects, plankton, and higher aquatic plants. The most acid lake (pH 2.7-3.2) supported only 26 different plants and animals. Bauxite open-pit lakes within the pH range studied appear to be as relatively unproductive as their coal strip-mine lake counterparts, with which they share physicochemical and biological characteristics. Benthic macrofaunal diversity and abundance appear to be related more closely to distribution and abundance of leaf detritus than to hydrogen-ion concentration. (Authors)

18198. Watson, N. H. F. (Great Lakes Biolimnol. Lab., Canada Centre for Inland Waters, Burlington, Ontario L7R 4A6, Canada). 1974. ZOOPLANKTON OF THE ST. LAWRENCE GREAT LAKES - SPECIES COMPOSITION, DISTRIBUTION, AND ABUNDANCE. J. Fish. Res. Board Can., 31(5): 783-794.

Recent studies of zooplankton of the St. Lawrence Great Lakes have concentrated on a broad synoptic coverage of sampling stations and repeated cruises throughout a growing season. This has resulted in a considerable amount of detail about seasonal changes in species composition, total numbers, and vertical and horizontal distributions. Investigators have treated the data to show differences in distribution over the lakes on a cruise and cruise mean averages for each lake, often weighted by area to provide relative abundance figures over the season and between lakes. Maximum numbers were observed in Lake Erie (225,000/m³). Considerably fewer organisms were found in periods of peak abundance in Lake Ontario (55,000/m³) and Lake Huron (22,000/m³). No firm estimates are available for Lake Superior but numbers from one cruise (8000/m³) indicate still lower values there. Biomass estimates (either as ash-free weight of material from planktonnet hauls or from conversions of numbers to biomass from dry weight factors for individual species) are highest for Lake Erie, but reflect the larger size of organisms in the other lakes, especially Huron and Superior. Species distributions are now reasonably well known for crustaceans, except in one or two taxa of the cladocerans *Daphnia* and *Bosmina* whose variability should be investigated more fully. Recent studies have been made on the rotifers, but their numbers, distribution, and ecological role is not fully defined. Similarly, the distribution and role of protozoan groups have been largely ignored. Several computer techniques are suggested for the handling and analysis of the large quantities of data generated on lakewide surveys including community coefficients and cluster analyses. More attention should be given to determining sampling intervals to obtain information which can precisely detect changes in abundance from year to year, and better population dynamics and production data are needed to relate zooplankton stocks to eutrophication. (Auth.)

18199. Satia, Benedict P. (Coll. of Fish., Univ. of Washington, Seattle, Washington 98195). 1974. QUANTITATIVE PROTEIN REQUIREMENTS OF RAINBOW TROUT. Prog. Fish-Cult., 36(2): 80-85.

Fingerling rainbow trout (*Salmo gairdneri*) developed at the University of Washington, Seattle, were pair-fed isocaloric diets containing approximately 3,800 cal of metabolizable energy per kilogram of diet over a 10-week period at ambient temperatures of 16° to 27°C. Rate of growth increased with increasing protein concentration in the diet. However, growth index plots ($\frac{\text{gain in weight}}{\text{food consumed}}$)

indicated a shift in protein requirements from 50% to 40% after 6 to 8 weeks. The chemical composition of the fish was altered by the levels and components of ingredients in the diets. (Auth.)

18200. Falter, C. M., and R. R. Ringe (Coll. of Forestry, Idaho Univ., Moscow, Idaho 83843). 1974. POLLUTION EFFECTS ON ADULT STEELHEAD MIGRATION IN THE SNAKE RIVER. Environ. Protection Agency, Ecological Res. Series Report EPA-660/3-73-017, 101 p., available from GPO Sup Doc as EPl.23:600/3-73-017, \$1.50; Selected Water Resources Abstracts, 7(17): p. 53.

A three-year field study was conducted in 1969-1971 to assess the relationship of kraft mill effluent and pre-impoundment water quality to adult steelhead trout (Salmo gairdneri Richardson) behavior in the Snake River, Idaho-Washington. Steelhead were tagged with ultrasonic tags and followed through a 25 km section of the proposed Lower Granite Reservoir. Limnological parameters were measured and compared with fish behavior. Mixing patterns of the Clearwater River with the Snake River were also assessed. Mean water quality changes in the Snake River as a result of pollution inputs in the study are very subtle. In terms of toxic effects from chemical loading, Snake River water quality is not greatly altered except in the immediate area of pollution input; steelhead avoidance of these localized problem areas, was not observed. No significant correlation could be made between any chemical water quality parameter and steelhead behavior. However, as temperature dropped below 15 C fish movement slowed, fish generally stopped moving at night, and resting periods increased in length and number. Steelhead showed a preference to move in water with off-bottom current velocities of 0.2 to 0.5 m/sec and showed a definite pattern of crossover and resting points.

18201. Rimler, R. B., E. B. Shotts, Jr., and P. Chittino. 1974. Aeromonas hydrophila INFECTIONS IN FISHES. RAPID DIAGNOSIS WITH THE HELP OF R. S. MEDIUM. (Infections a Aeromonas hydrophila chez les poissons. Diagnostic rapide a l'aide du milieu R. S.). Cah. med. vet., 43: 47-52; Fish Health News, 3(3): p. 13.

Diagnosis of Aeromonas hydrophila infections of fish is often delayed due to difficulties encountered in isolation and identification. The use of a presumptive method using Rimler-Shotts medium is demonstrated. Use of this technique with clinical diagnosis will reduce the time necessary for confirmation and institution of therapy. (Authors)

18202. Petty, Lorna L., and John J. Magnuson (Lab. of Limnol., Dept. of Zool., Univ. of Wisconsin, Madison, Wis. 53706). 1974. LYMPHOCYSTIS IN AGE 0 BLUEGILLS (Lepomis macrochirus) RELATIVE TO HEATED EFFLUENT IN LAKE MONONA, WISCONSIN. J. Fish. Res. Board Can., 31(7): 1189-1193.

The viral disease lymphocystis was more common in age 0 bluegills (Lepomis macrochirus) in an area of Lake Monona heated by a power plant outfall than in unheated reference areas. Approximately 14,000 fish collected from July through October 1971 were examined. The infection became prevalent in mid-September and attained a maximum incidence in early October, when 11.6% of age 0 bluegills in the heated area had lesions in comparison with 5.5% in unheated areas in late September. Infected fish were longer than uninfected fish and usually exceeded 50 mm TL. Fish 50 mm long in the heated and in the unheated areas had similar lymphocystis incidence. Thus, higher lymphocystis incidence in heated than in unheated waters was largely explained by the greater percentage of bluegills longer than 50 mm TL in the outfall area. Leeches (Piscicola reducta) also were more prevalent in the heated area and may have increased lymphocystis incidence by creating foci for viral penetration or by acting as vectors. Slightly higher condition factors of infected than of uninfected bluegills were unexplained. (Authors)

18203. Reinecker, Richard H., and Mary O. Ruddell (The Research Inst. of the Gulf of Maine, Portland, Maine 04103). 1974. AN EASILY FABRICATED OPERATING TABLE FOR FISH SURGERY. Prog. Fish-Cult., 36(2): 111-112.

An operating table was constructed to perform surgical procedures on winter flounder (Pseudopleuronectes americanus). The table offers an effective means of restraining anesthetized fish, insures respiration through a recirculating seawater system, allows viewing of internal anatomy, and causes no apparent trauma. (Authors)

18204. McNeely, David L., and William D. Pearson (Dept. of Biol. Sci., North Texas State Univ., Denton, Texas 76203). 1974. DISTRIBUTION AND CONDITION OF FISHES IN A SMALL RESERVOIR RECEIVING HEATED WATERS. Trans. Amer. Fish. Soc., 103(3): 518-530.

The effects of a thermal effluent on the distribution and condition of fishes were determined in a 330-ha reservoir in northeastern Texas. Fish were collected at five stations with 41-m experimental gill nets and a 6.1 m seine every 2 weeks between May 1971 and June 1972. Water temperatures at the mouth of the effluent canal were highest (42.2 C) in July and were typically 38 C higher at this location than in other areas of the reservoir. Two forage species (*Mississippi silversides*, *Menidia auctens*, and pugnose minnow, *Notropis emilae*) were never found near the mouth of the effluent canal. White crappie (*Pomoxis annularis*) and river carpsucker (*Cyprinus carpio*) may have been attracted to the effluent area in spring and summer. Channel catfish, (*Ictalurus punctatus*), gizzard shad (*Dorosoma cepedianum*), threadfin shad (*D. petenense*), and bluegill (*Lepomis macrochirus*) were rather evenly distributed over the entire reservoir during all seasons. The size and condition of fishes collected at the mouth of the effluent canal were not significantly different from those of fish collected at other stations in the reservoir, although the condition coefficients of channel catfish, river carpsucker, gizzard shad, threadfin shad, and bluegill were lower than those reported for these species in other parts of the United States. The results suggest that in a small reservoir like North Lake the effects of a heated effluent on fish populations may be generalized over the entire body of water, particularly when a cool-water refuge area is present beneath the heated surface stratum. (Authors)

18205. Harrington, Robert W., Jr. (Fla. Med. Entomol. Lab., Fla. Div. of Health, P. O. Box 520, Vero Beach, Florida 32960). 1974. SEX DETERMINATION AND DIFFERENTIATION IN FISHES. In: C. B. Schreck, ed. Control of Sex in Fishes. Sea Grant and V.P.I. & S. U. Press, VPI-SG-74-01: 4-12.

In the chains of causes from chromosome level to earliest definitive female or male elements in differentiating gonads, few links have been described. Of these, some are newly open to question or reinterpretation. The conceptual framework which, for many years, has guided research on sex determination and differentiation rests upon theories that still retain potent explanatory or didactic utility at more abstract levels of problem formulation but that have become increasingly difficult to reconcile with empirical data at more concrete levels. Generalizations of reviewers relying on secondary sources or uncritical acceptance of authors' conclusions are not necessarily valid. Researchers on fishes are well advised to scrutinize *in toto*, themselves, both older and current literature. The diversity among the 20,000 species of teleosts and our small uneven knowledge of their sexuality do not warrant generalization. Sex determination and differentiation are virtually inseparable. In a short account, bias cannot altogether be avoided and it seems best to emphasize wide open questions presently confronting those seeking to find out how the genetically-prescribed sex is actualized as the phenotypic sex and how such actualization can be deflected to produce the opposite sex. (Auth.)

18206. Paetz, M. J., and K. A. Zelt (Fish & Wildl. Div., Alberta Dept. of Lands and Forests, Edmonton, Alberta, Canada). 1974. STUDIES OF NORTHERN ALBERTA LAKES AND THEIR FISH POPULATIONS. J. Fish. Res. Board Can., 31(5): 1007-1020.

The limnology and fisheries of four Alberta lakes (Cold Lake, Lac La Biche, Lesser Slave Lake, and Wabamun Lake) were described. The general description included glacial history, climate, human development, physical and chemical characteristics, plankton and macroinvertebrates, and fish species composition. Age-length relation for lake whitefish (*Coregonus clupeaformis*) and ciscoes (*C. artedii*) from the individual lakes was presented and compared with the limnological condition of the particular lake. The commercial lake whitefish yield of each lake was also compared with the physical and chemical characteristics. (Authors)

18207. O'Brien, D. J. (Dept. of Agric. and Fish., Vet. Res. Lab., Abbotstown, Castleknock, Co. Dublin, Eire). 1974. USE OF LESION FILTRATES FOR THE TRANSMISSION OF UDN (ULCERATIVE DERMAL NECROSIS) IN SALMONIDS. J. Fish Biol., 6(4): 507-511.

Spawning Atlantic salmon, Salmo salar (L.), brown trout, Salmo trutta (L.) and rainbow trout, Salmo gairdneri (Richardson) were held in tanks for four weeks and then injected with filtrates from lesions of salmon naturally infected with UDN. In some cases prednisolone acetate was included in the inoculum. Water temperatures were recorded daily and the time of appearance of the lesions was noted. Passage experiments using extracts of these lesions were carried out. (Auth.)

18208. Ryck, Frank M., Jr. 1974. WATER QUALITY SURVEY OF THE SOUTH-EAST OZARK MINING AREA 1965-1971. Aquatic Series No. 10, Missouri Dept. of Conservation, Jefferson City, Missouri, 28 p.

The pollution of a number of Ozark streams by lead mining, milling and smelting was documented by collections of bottom dwelling invertebrates made by the Missouri Department of Conservation over the years 1965-1971. Typically, samples collected from unpolluted streams had diversity index values of at least 4.0 and eight or more taxa of pollution sensitive mayflies and stoneflies. Samples from polluted streams had reduced diversity and fewer than eight types of mayflies and stoneflies. Streams that had pollution problems as a result of lead operations were: Strother Creek downstream from the Missouri Lead Operating Company Buick Project, Bee Fork Creek downstream from the St. Joe Minerals Corporation Fletcher Division, Indian Creek downstream from the St. Joe Minerals Corporation Viburnum Division, Big Creek downstream from the American Smelting and Refining Company smelter at Glover, and Flat River Creek downstream from the St. Joe Minerals Corporation Federal Division. Streams that appeared to have developing problems as a result of lead operations were: Neals Creek downstream from the Magmont Project of Cominco American and Dresser Minerals, and Crooked Creek and portions of Huzzah Creek downstream from the Missouri Lead Operating Company smelter at the Buick Project. Iron mining and milling operations at the Pea Ridge Mine of Meramec Mining Company polluted Little Courtois Creek since the start of this survey. Streams that did not show any adverse effects from mining or industrial operations in their watershed were: Logan Creek downstream from the Adair Creek Project of Ozark Lead Company, Bills Creek downstream from the construction of the Brushy Creek Mine and Mill of St. Joe Minerals Corporation, Indian Creek downstream from the Indian Creek Division of St. Joe Mineral Corporation, Huzzah Creek downstream from Shaft 27 of the Viburnum Division of St. Joe Minerals Corporation, Big Creek downstream from the Ruberoid Company plant in Anapolis, and Knob Creek downstream from the Pilot Knob Mining and Pellet Company. (Auth.)

18209. Anonymous. 1974. NUTRIENT REQUIREMENTS OF TROUT, SALMON, AND CATFISH. Report No. ISBN 0-309-02141-3, National Acad. of Sciences, Printing and Publishing Office, 2101 Constitution Ave., Wash., D.C. 20418, 57 p. paperbound, \$3.25; NOAA Marine Fisheries Abstracts, 27(7): 23.

This report contains a summary of the known nutrient requirements of trout, salmon, and catfish and a discussion of special considerations for diet formulation and storage. Tables of feed composition are included. The contents are as follows: Energy and metabolism in fish; Protein and amino acid requirements; Lipid requirements; Carbohydrates; Vitamins; Minerals; Excess, hypervitaminosis, and advertisements; Toxins; Symptoms of nutritional deficiency; Feed processing and storage; Composition of feeds; Tables; Appendix: typical test diets; Bibliography.

18210. Krema, Richard F., and Winston E. Farr (Northwest Fish. Center, NMFS, Seattle, Washington 98112). 1974. FLOATING FISH TRAP FOR CAPTURE OF HOMING SALMON. Prog. Fish-Cult., 36(2): 105-107.

A floating fish trap with an upwell weir was constructed to capture adult coho salmon (Oncorhynchus kisutch) returning to a springwater supply. As juveniles the fish had been held in the springwater about 48 hrs before being released. The overall dimensions of the trap were 8'0" x 21'6" x 6'6" with a fish collection pen that measured 7'0" x 3'0" x 4'0". It was a very efficient collector of these salmon. (Authors)

18211. Wilson, Robert P., and William E. Poe (Dept. of Biochem., Mississippi State Univ., Mississippi State, Miss. 39762). 1974. NITROGEN METABOLISM IN CHANNEL CATFISH, *Ictalurus punctatus* - III. RELATIVE POOL SIZES OF FREE AMINO ACIDS AND RELATED COMPOUNDS IN VARIOUS TISSUES OF THE CATFISH. Comp. Biochem. Physiol., 48(4B): 545-556.

Free amino acids and related compounds were determined in serum, liver, muscle, gill, gut tract, kidney, heart, brain and spleen tissues of fasting cultured channel catfish. Taurine and ammonia were the major constituents of all tissues studied. In general, the liver and kidney contained the highest concentration, expressed as $\mu\text{moles/g}$ tissue, of most of the amino acids and related compounds. However, on a percent distribution of the total pool sizes, the muscle tissue contains by far the largest percentage of almost all compounds studied. Of the protein amino acids, alanine, glycine and glutamic acid were found to be present in the highest concentrations. Contrary to previous reports, glutamine was not found as the major constituent of the various tissues. (Authors)

18212. Festa, Patrick J. 1974. ANALYSIS OF MARKET SIZE COMPOSITION DATA FOR THE NEW JERSEY SUMMER FLOUNDER COMMERCIAL FISHERY - 1967 THROUGH 1972. N. J. Dept. of Environ. Protection, Bur. of Fisheries, Nacote Creek Research Sta. Miscellaneous Report No. 12M, 11 p. + 6 tabs + 7 figs.

A backlog of commercial dock receipts for the years of 1967 thru 1972 were analysed to obtain size composition data for the New Jersey commercial landings of summer flounder. These records break down landings into four market size categories. Because of year to year variations in the availability and quality of the records, yearly poundage data were converted to percentage figures. The contribution by weight of small fish to the sampled landings varied from 2% to 13% of the total yearly fish catches. The data obtained does not support the use of percent weight composition figures in monitoring stock recruitment rates for the species. A comparison of catch size compositions in the estuarine sport fishery and the nearshore commercial fishery displayed little correlation by month or year over the study period. The report also offers a review of summer flounder landings in New Jersey from 1939 till 1972. (Auth.)

18213. Tindle, Roger C. (U.S. Fish and Wildlife Service, Fish-Pesticide Res. Lab., Columbia, Missouri 65201). 1972. HANDBOOK OF PROCEDURES FOR PESTICIDE RESIDUE ANALYSIS. Technical Papers of the Bureau of Sport Fish. and Wildlife No. 65, IV parts + appendices and publications of interest.

18214. Schultz, Donald P., and Eugene W. Whitney (Southeastern Fish Control Lab., Fish and Wildlife Service, U.S. Dept. of the Interior, Warm Springs, Georgia 31830). 1974. MONITORING 2,4-D RESIDUES AT LOXAHATCHEE NATIONAL WILDLIFE REFUGE. Reprinted with permission by the U.S. Environmental Protection Agency from Pesticides Monitoring Journal, 7(3/4): 146-152.

Over 7,000 acres along the Hillsboro perimeter canal in Loxahatchee National Wildlife Refuge (NWR), Florida, were sprayed in 1971 with the dodecyl-tetradecyl amine salts of 2,4-D (DTA-2,4-D) at a rate of 4.48 kg acid equivalent (a.e.) per hectare to control waterhyacinth (*Eichornia crassipes*). Three stations were established along the canal to collect samples of fish, water, and mud for residue analysis and to monitor water quality. The initial application of 2,4-D, followed by spot treatments of DTA-2,4-D and/or the dimethylamine salt of 2,4-D (DMA-2,4-D) over a 4-month period, achieved excellent control of waterhyacinth. The highest 2,4-D residue level measured in water (0.037 mg/l) was found on the day following the initial treatment. The highest levels in hydrosol (0.005 mg/kg) occurred 3 to 15 days after treatment. Among 60 samples of fish, 3 had herbicide residue levels greater than 0.010 mg/kg, 16 had less than 0.010 mg/kg, and the remainder had no detectable residue levels. Breast muscle and liver of common Florida gallinules (*Gallinula chloropus*) had residue levels of 0.30 mg/kg and 0.675 mg/kg, respectively, 1 day after spraying, and no detectable residues 4 days after spraying. The herbicide apparently caused no ill effects on hatching of boat-tailed grackle (*Cassidix mexicanus*) eggs or development of fledglings. (Authors)

18215. Speirs, Garrett D. (Maine Coop. Fish. Unit, Univ. of Maine, Orono, Maine 04473). 1974. FOOD HABITS OF LANDLOCKED SALMON AND BROOK TROUT IN A MAINE LAKE AFTER INTRODUCTION OF LANDLOCKED ALEWIVES. Trans. Amer. Fish. Soc., 103(2): 396-399.

Stomach analysis of landlocked Atlantic salmon and brook trout from Echo Lake, Maine, indicated that salmon relied more on open water prey (landlocked alewives, rainbow smelt and terrestrial insects) than did brook trout, which fed more on bottom and shoreline prey (sticklebacks, killifish and aquatic invertebrates). Most fish were eaten by salmon and trout in summer and few were eaten in winter. Young-of-the-year alewives constituted an important portion of the salmon diet, especially in late summer, but were not significant forage for trout. The isopod Asellus racovitzai racovitzai was important forage for trout in winter and spring. A review of studies concerning food habits of salmon and trout indicates utilization of pelagic forage fish is related to lake area. (Auth.)

18216. Christie, W. J. (Fish and Wildl. Res. Branch, Ont. Min. of Nat. Res., Maple, Ontario, Canada). 1974. CHANGES IN THE FISH SPECIES COMPOSITION OF THE GREAT LAKES. J. Fish. Res. Board Can., 31(5): 827-854.

This paper is an interpretive review of the "case histories" which documented the changes in each of the Laurentian Great Lakes for the 1971 symposium on Salmonid Communities in Oligotrophic Lakes (SCOL). It suggests that lakes Huron, Michigan, and Superior passed through a parallel series of stock changes after the invasions of those lakes by the sea lamprey. First, the lake trout and burbot stocks collapsed, and then with the relaxation of predation pressure rainbow smelt, deepwater cisco, and alewife stocks increased. Lake herring stocks collapsed in apparent response to the smelt increase. Whitefish were affected by sea lamprey but recovery after the control of the lamprey in lakes Michigan and Superior suggested that the exotic species had little influence. Lake Ontario differed from the other lakes in that it was inhabited by both sea lamprey and alewife before the turn of the century, and provided the reservoir from which these species expanded to colonize the upper lakes. Alewife apparently equilibrated early, but the evidence was that more recent perturbations allowed the sea lamprey to become a significant factor in the loss of the piscivores of Lake Ontario. Subsequent proliferation of ciscoes and smelt, and collapse of the herring, followed a sequence similar to that of the upper lakes. Lake Erie seemed to be similarly affected by loss of predator stocks, but its predominantly eutrophic character made the situation more complex. Overfishing was indicted in many early stock collapses, in the early invasion of the smelt in lakes Huron and Michigan and in the recent cisco declines of lakes Ontario and Huron. Eutrophication and more direct pollution stresses had mainly inshore impacts, but the similarity in the species sequencing in the oligotrophic Great Lakes suggested that although these factors may have supplemented the other effects, their influence before about 1950 was less than that of overfishing and the invasion of exotic species. Control of sea lamprey, overfishing, and eutrophication seemed attainable in the Great Lakes, but the only defense against further invasions by pest species appeared to be maintenance of sufficiently dense piscivore stocks to assure their suppression. Determining the levels of harvest appropriate to this provision will require intensified research. (Auth.)

18217. Shireman, Jerome V. (Iowa Coop. Fish. Unit, Ames, Iowa 50010). 1974. SERUM PROTEIN VARIABILITY IN BLUEGILLS, Lepomis macrochirus Rafinesque, FROM IOWA FARM PONDS. Trans. Amer. Fish. Soc., 103(3): 630-632.

Four-hundred-and-forty-six electrophoretic patterns of bluegill (Lepomis macrochirus) serum proteins were analyzed to determine the condition of fish when sampled from ponds with different population densities. It was extremely difficult to rank ponds according to population density by using electrophoresis because of intraspecific variation. This variation was attributed to sex, maturity, season, and ponds, but not all the variation was accounted for in these variables. (Auth.)

18218. Hare, G. M., and C. Frantsi (Dept. of the Environ., Mactaquac Fish Culture Sta., Fredericton, New Brunswick, Canada). 1974. ABUNDANCE AND POTENTIAL PATHOLOGY OF PARASITES INFECTING SALMONIDS IN CANADIAN MARITIME HATCHERIES. J. Fish. Res. Board Can., 31(6): 1031-1036.

Seventeen parasite species (3 protozoans, 11 helminths, 2 arthropods, and 1 mollusc) were collected from 317 Atlantic salmon (Salmo salar), 207 brook trout (Salvelinus fontinalis), and 34 rainbow trout (Salmo gairdneri) in the 13 Canadian Maritime hatcheries during 1972. Four parasites, Camallanus oxycephalus, Pomphorhynchus bulbocolti, Hydrachna sp., and a glochidium, were recorded from Atlantic salmon for the first time. Incidence and intensity of infection were high for Trichophyra piscium, Diplostomulum spathaceum, and glochidia infecting salmon and for Acanthocephalus lateralis and Salmincola edwardsii infecting brook trout. Infection intensity of Apophallus imperator, D. spathaceum, S. edwardsii, and glochidia increased with host age. Apophallus imperator and S. edwardsii were host specific to brook trout and the glochidium was host specific to salmon. Sterlia-dochona tenuissima and A. lateralis were more abundant in brook trout than in salmon. Pathology was associated with infections of Hexamita salmonis, D. spathaceum, A. lateralis, and S. edwardsii. (Authors)

18219. Nagayama, Fumio, and Hiroshi Ohshima (Tokyo Univ. of Fish., Konan 4, Minato-ku, Tokyo). 1974. STUDIES ON THE ENZYME SYSTEM OF CARBOHYDRATE METABOLISM IN FISH - I. PROPERTIES OF LIVER HEXOKINASE. Bull. Jap. Soc. Sci. Fish., 40(3): 285-290. In Japanese with English abstract.

Hexokinase isozymes were isolated by DEAE-cellulose column chromatography from the liver extracts of the common carp, grass carp, silver carp, eel, yellowtail, and rainbow trout. There are four types of hexokinase isozyme in the fish liver, and the isozyme composition seems to be species specific: isozymes A and B (22:78) in the common carp, B (100) in the grass carp, B and C (47:53) in the silver carp, B, C and D (6:27:67) in the eel, C and D (75:25) in the yellowtail, and D (100) in the rainbow trout. From the elution patterns and Km values for glucose and ATP, it appears that fish isozymes A and D resemble mammalian isoenzymes I and III, respectively, while isozymes B and C resemble II. Isozyme D of the rainbow trout or the yellowtail is inhibited by high concentrations of glucose while the other isozymes are not. An isozyme resembling mammalian isozyme IV (glucokinase) is not detectable in fish liver. A possible relationship between hexokinase and glucose utilization in fish is discussed.

18220. Morgans, Leland F. (Dept. of Biol., Univ. of Arkansas at Little Rock, Little Rock, Arkansas 72204). 1972. HISTOLOGICAL STUDY OF LIVER OF CHANNEL CATFISH, Ictalurus punctatus. Arkansas Acad. Sci. Proc., Vol. 26, pp. 67-69.

Histologically the liver of the channel catfish, Ictalurus punctatus, was found to consist of many lobules. Though not surrounded by a connective tissue sheath as they are in some animals, the lobules were discernable because all the hepatic cells in a particular area radiated from a central vein. Portal triads were scattered throughout the liver. The lobule tissue consisted of radiating cords of cells alternating with sinusoids. Glycogen was condensed into large vacuoles within these cells. Pancreatic tissue was found in the liver, always surrounding a capillary or venule. Morphologically the pancreatic cells were exocrine. Functionally, however, they may be endocrine cells because no ducts were found leading away from them. Connective tissue in the liver was scanty. (Auth.)

18221. Allen, George H., and Larry Dennis (Fisheries, School of Nat. Res., Humboldt State Univ., Arcata, California 95521). 1974. REPORT ON PILOT AQUACULTURE SYSTEM USING DOMESTIC WASTEWATERS FOR REARING PACIFIC SALMON SMOLTS. Environ. Protection Technology Series EPA-660/2-74-041, Wastewater Use in the Production of Food and Fiber--Proceedings, pp. 162-198.

Coho fingerling and chinook fry can be successfully reared in advanced secondarily treated domestic wastewaters mixed with saltwater. The best results in our studies were in mixtures producing 10-15 ‰ salinity (roughly two parts effluent to one part saltwater). (From Authors' conclusions)

18222. Casteel, Richard W. (Dept. of Anthropol., Univ. of Washington, Seattle, Washington 98195). 1974. IDENTIFICATION OF THE SPECIES OF PACIFIC SALMON (GENUS Oncorhynchus) NATIVE TO NORTH AMERICA BASED UPON OTOLITHS. Copeia No. 2, pp. 305-311.

The range of variation in otolith form of five species of Pacific salmon is discussed. A key is included to aid in the identification of anadromous adults, jacks and mature adults taken at sea, along with photographs of the otoliths of each species and some of the variations in form which might be expected. The accuracy of the key was tested on a group of untrained individuals and found to range in accuracy from 65.6% (O. nerka) to 94.5% (O. tshawytscha), depending upon species. Otoliths from lacustrine populations of O. nerka were significantly more often misidentified than those from anadromous individuals of the same species. (Auth.)

18223. Skrzynski, W. (Fish. Mgmt Div., Min. of Agric. and Fish., Wellington, New Zealand). 1974. REVIEW OF BIOLOGICAL KNOWLEDGE ON NEW ZEALAND FRESHWATER EELS (Anguilla spp.). N. Z. Min. of Agric. and Fish., Fisheries Technical Report No. 109, 37 p.

Two species of freshwater eels, the long-finned eel, Anguilla dieffenbachii and the short-finned eel, Anguilla australis schmidtii are widely distributed throughout New Zealand and the adjoining islands including the Chatham Islands. Published ecological knowledge on both species is reviewed and current research projects are outlined. Emphasis is placed on topics of current interest related to heavy commercial exploitation of eels in the last few years. These topics include the rates of growth and recruitment and the effects of eel removal on trout, the most important freshwater game fish in New Zealand. (Auth.)

18224. Evans, Wallace A. (Dept. of Zool., Brigham Young Univ., Provo, Utah 84601). 1974. THE HISTOPATHOLOGY OF CUTTHROAT TROUT EXPERIMENTALLY INFECTED WITH THE BLOOD FLUKE Sanguinicola klamathensis. J. Wildl. Dis., 10(3): 243-248.

The pathological effects of the blood fluke, Sanguinicola klamathensis Wales 1958, was studied in the cutthroat trout host (Salmo clarki). Cutthroat trout fingerlings of a non-infected group and a group experimentally infected by exposure to 6,000 Fluminicola fusca snails, with a 6% prevalence of infection with S. klamathensis, were maintained for 7 months. The experimental group had 80% mortality after 3 months exposure to the blood flukes. Histopathology revealed a progressive infection with fluke eggs and miracidia within the gills, kidney, and heart as evidenced by necrosis and calcification of heart and kidney tissue, and hyperplasia of the gills. (Auth.)

18225. FAO of the United Nations (Rome, Italy). 1974. MANUAL OF FISHERIES SCIENCE. PART 2 - METHODS OF RESOURCE INVESTIGATION AND THEIR APPLICATION. FAO Fish. Tech. Paper No. 115, Rev. 1. (Distribution restricted).

Text includes: Introduction to fisheries science; Population and sampling; The measurement of fish and shellfish; Age determination and age composition; Sex, maturity and fecundity; Food and feeding; The aquatic environment; Unit stocks, migrations and stock differentiation; The effect of fishing on fish. (From contents)

18226. Fay, Richard R. (Lab. of Sens. Sci., Univ. of Hawaii, 1993 East-West Road, Honolulu, Hawaii). 1974. SOUND RECEPTION AND PROCESSING IN THE CARP: SACCULAR POTENTIALS. Comp. Biochem. Physiol., 49(1A): 29-42.

Saccular potentials were recorded from two locations in the endolymphatic system of the carp to sound stimulation. The frequency response function recorded from the sacculus is essentially identical with the behavioral function for the goldfish, confirming that the sacculus is the primary acoustic detector of the ostariophysine ear. Measurements of the non-linearities in the saccular potentials illustrate the complex organization of the saccular macula, and a possible mechanism for signal-to-noise improvement and frequency analysing capability is suggested which is independent of a cochlear-like spatial analysis. (Auth.)

18227. VanVooren, Allan R., and David H. Davies. 1974. SURVEY OF FISH SPECIES IN OHIO WATERS OF LAKE ERIE. Ohio Dept. of Nat. Res., Lake Erie Fishery Research Study No. II, Fed. Aid Proj. No. F-35-R-12, 68 p.

Eighteen index stations in the Ohio waters of Lake Erie were surveyed by trawling and/or gill netting during 1973. Data were collected from walleye, yellow perch, white bass and channel catfish to determine their relative numbers, seasonal abundance, growth rates and maturity. Adult walleye were more abundant in 1973 than during any of the nine survey years. Adult yellow perch were at their lowest level with only poor year classes being recruited. Growth of all species during 1973 was somewhat greater than during 1972. Additional findings on the status of forage species and diurnal gill net catch rates are also presented. Twenty-one net run samples of walleye, yellow perch, white bass, and channel catfish were examined from various commercial gears in the Ohio waters of Lake Erie during 1973. Data were collected and analyzed to determine their age, size composition, maturity, and seasonal abundance. One or two year classes dominated the samples of walleye, yellow perch and white bass. Over 90 percent of the walleye and white bass captured in commercial gear were of legal size. Less than one-third of the catfish captured were of legal size. Size and age composition of all four species varied between gears and/or areas. The bulk of the commercial white bass and channel catfish harvest occurred along the south shore of the Western Basin and Sandusky Bay. The greatest yellow perch harvest occurred in the Central Basin. (Authors)

18228. Sly, P. G., and R. L. Thomas (Dept. of the Environ., Environmental Mgmt Serv., Canada Centre for Inland Waters, Burlington, Ontario, Canada). 1974. REVIEW OF GEOLOGICAL RESEARCH AS IT RELATES TO AN UNDERSTANDING OF GREAT LAKES LIMNOLOGY. J. Fish. Res. Board Can., 31(5): 795-825.

A review of studies on the geology of recent sediment deposits in the Great Lakes is presented. A summary of quaternary events and a cross-correlation between each of the major basins has been attempted; in this respect it is essential to realize the control imposed upon present depositional conditions by the preceding sedimentary environments (often related to significantly different lake levels). Sediment/energy relations have been discussed, particularly in the context of large lake limnology. Geochemical topics include major and trace metal data, the formation of ferromanganese deposits, and major nutrients (C, N, and P); published material covering these topics is, however, rather limited. Throughout this review the authors have attempted to show the interrelations between such geological evidence and physical, chemical, and biological processes; further, the application of such information to human oriented problems. (Authors)

18229. Pister, Edwin P. (Calif. Dept. of Fish and Game, Bishop, California 93514). 1974. DESERT FISHES AND THEIR HABITATS. Trans. Amer. Fish. Soc., 103(3): 531-540.

Recent habitat degradation within the desert areas of the southwestern United States and adjoining areas of Mexico has seriously depleted endemic fish populations. During the past 35 years, 4 species and 6 subspecies in 6 genera apparently have become extinct within California, Nevada, and Arizona, and at least 50 additional species and subspecies within 8 Great Basin states and northern Mexico are considered threatened. Of these, 19 are currently listed as endangered by the Secretary of the Interior. The urgency and complexity of the problem caused several governmental agencies to combine in 1970 with other concerned parties and form the Desert Fishes Council. This was done to improve communications and assist in the development of an interagency preservation program, the primary purpose of which was to reduce the rate of habitat destruction. A Pupfish Task Force established by the Department of the Interior in 1970 coordinated efforts of that agency and initiated an effective program based upon protection of native habitats. The Desert Fishes Council continues as an active participant. The methodology developed may prove useful in solving similar problems as they occur elsewhere. (Auth.)

18230. Ellis, Robert J. (Auke Bay Fish. Lab., NMFS, NOAA, Auke Bay, Alaska 99821). 1974. DISTRIBUTION, ABUNDANCE, AND GROWTH OF JUVENILE SOCKEYE SALMON, *Oncorhynchus nerka*, AND ASSOCIATED SPECIES IN THE NAKNEK RIVER SYSTEM, 1961-64. U.S. Dept. of Comm., NOAA Tech. Report NMFS SSRF-678, 53 p.

The Naknek River system contains eight interconnected and generally biologically discrete basins, each with a different ratio of spawning grounds to rearing area for sockeye salmon, *Oncorhynchus nerka*, and different densities of juvenile sockeye salmon and associated species of fish. Juvenile sockeye salmon and other pelagic species were sampled with tow nets at night. Sockeye salmon were the most common and abundant species in all basins, followed by threespine sticklebacks, minispine sticklebacks, and pond smelt. Eighteen other species of potential competitor or predator fish were present. In the summers of 1961 to 1963, juvenile sockeye salmon in the pelagic areas had a characteristic pattern of abundance for the entire system: abundance (catch per tow) of age 0 increased from early summer to midsummer and then declined to late August. The abundance in late August varied about threefold and, in general, was independent of variations in the number of parents from 1960 to 1963. In July the abundance of age 0 fish in each basin was proportional to the amount of known contiguous spawning ground, but by late August this relation no longer existed. This change was at least partly due to migration of the age 0 fish - generally from basins of greater abundance of fish to those of lesser abundance. The larger and faster growing fish were the first to migrate. Not all basins were involved in these migrations. The production of sockeye salmon smolts in the Naknek system is relatively stable. At least three major factors probably contribute to this stability: (1) the presence of several major spawning units or races in widely separated spawning grounds of different types, (2) the presence of several connected lakes, and (3) the migratory behavior of juvenile sockeye salmon during their first summer. A mechanism which prevents the population of juvenile sockeye salmon from exceeding some upper limit is not apparent in the Naknek system. A reduction in growth in areas of high density was not apparent in the Naknek system in 1961-64 and apparently did not occur in 1957-65. Many kinds of predators on juvenile salmon are present but probably are not limiting production of smolts. The data on abundance and growth of juvenile sockeye salmon and the distribution of the escapement and spawning grounds indicate that it should be possible to increase the production of sockeye salmon in the Naknek system. Two of the major basins, North Arm and Brooks Lake, which constitute about 35% of the system, are not producing juveniles at very low levels. North Arm appears to suffer from too little spawning area, whereas Brooks Lake appears to have adequate spawning area but too few spawners. Three factors in the biology of juvenile sockeye salmon of the Naknek system are of special significance to the managers of the resource and should be investigated in any effort to enhance the production of sockeye salmon in the Naknek system: (1) the abundance of smolts each spring is fairly constant for the system as a whole and not closely related to the abundance of the parents or, from 1961-64, even to the original abundance of age 0 fish; (2) the apparent growth of juvenile sockeye salmon and potential competitor species is not related to the abundance of these fish in any lake of the Naknek system; and (3) two major lakes, constituting about 35% of the rearing waters, do not receive age 0 sockeye salmon from other basins and are supporting relatively few sockeye salmon. The question of what escapement of adult sockeye salmon is needed to ensure full production of juveniles is considered. The present study indicates that escapements in the range of 600,000 to 1,000,000 fish, as recommended by other studies, would probably fully use the present combination of spawning and rearing areas without danger of overburdening the food supply. (Auth.)

18231. Vosdingh, R. A., and M. J. C. Neff (311 Forrest Hill, San Antonio, Texas). 1974. BIOASSAY OF AFLATOXINS BY CATFISH CELL CULTURES. Toxicology, No. 2, pp. 107-112; Fish Health News, 3(3): p. 14.

A line of catfish cells, brown bullhead, was tested as an *in vitro* bioassay system for aflatoxins. The cells were found to be sensitive to 0.02 µg/ml of aflatoxin B₁. The rate of cellular degeneration in the cultures was related to the dose of aflatoxin B₁. (Authors)

18232. Norcross, J. J., S. L. Richardson, W. H. Massmann, and E. B. Joseph (Virginia Inst. of Mar. Sci., Gloucester Point, Virginia 23062). 1974. DEVELOPMENT OF YOUNG BLUEFISH (Pomatomus saltatrix) AND DISTRIBUTION OF EGGS AND YOUNG IN VIRGINIAN COASTAL WATERS. Trans. Amer. Fish. Soc., 103(3): 477-497.

Cruises were made off Chesapeake Bight from December 1959 through April 1963 to determine species composition and distribution of fishes spawned on the Continental Shelf. Illustrations of young fish, herein provided, now complete figures from newly hatched larvae to juveniles. Verbal descriptions provide prominent features of young bluefish to aid in identification and osteological development and to compare similar appearing larvae. Bluefish larvae can be distinguished from similar appearing species (Peprilus triacanthus and Urophycis chuss) with which they were taken in Chesapeake Bight by myomere numbers and pigment patterns. Bluefish larvae closely resemble the larval scombrids, Scomber scombrus and S. japonicus, and larval carangids. They may be separated by myomere numbers or relative lengths of the preopercular spine. Continental Shelf waters off the Virginia-North Carolina coast are major spawning grounds of bluefish. Major spawning sites in the Chesapeake Bight were located over the outer half of the shelf between 55 km (30 nautical mi) and 148 km (80 nautical mi) offshore and where water temperatures were 22 C or greater and surface salinities were 31 ‰ or greater. Minimum temperature at the onset of spawning was 18 C and minimum salinity was 26.6 ‰. Our data show that bluefish spawning commences in June, peaks in July, and continues into August. Peak spawning activity occurred in early evening near sundown (1900-2100 hr). Eggs are thought to be transported south and offshore by prevailing surface currents. Larval bluefish inhabit surface waters and greatest numbers were found near the edge of the Continental Shelf. Juvenile bluefish move inshore during their first growing season. Despite intensive sampling, none were captured in offshore waters. We speculate that with growth young bluefish move to depths above the thermocline. We suspect that the most important single factor in determining the fate of every year class is the circulation of Continental Shelf waters. (Authors)

18233. Ooshiro, Zentaro, Masakazu Fukushima, and Seiichi Hayashi (Fac. of Fish., Kagoshima Univ., Shimoaratacho, Kagoshima, Japan). 1974. STUDIES ON MYOKINASE IN THE MUSCLE OF FISHES - I. ISOLATION AND PURIFICATION OF MYOKINASE ISOZYMES FROM MUSCLE OF CARP. Bull. Jap. Soc. Sci. Fish., 40(3): 391-398. In Japanese with English abstract.

Myokinase (ATP:AMP phosphotransferase, EC 2.7.4.3) catalysing the equilibrium among ATP, ADP and AMP, was isolated from the extract of carp muscle by ammonium sulfate fractionation, Sephadex G-75, and by DEAE-cellulose and CM-cellulose column chromatography. The separation of two distinct forms of myokinase into different fractions was brought about by gel filtration on Sephadex G-75. These enzymes were termed myokinase I and myokinase II in order of elution from the column. Myokinase I was further purified by means of DEAE-cellulose column chromatography, while myokinase II was further purified on CM-cellulose columns. These purified myokinase isozymes appeared homogeneous on disc gel electrophoretic analysis. This fact suggested that, in spite of the seeming identity of the substrate specificities of these two enzymes, these two forms of myokinase isozymes are composed of different types of proteins.

18234. Nickelson, T. E., and G. L. Larson (Dept. of Fish. and Wildl., Oregon State Univ., Corvallis, Oregon 97331). 1974. EFFECT OF WEIGHT LOSS ON THE DECREASE OF LENGTH OF COASTAL CUTTHROAT TROUT. Prog. Fish-Cult., 36(2): 90-91.

Loss of body weight was frequently found associated with losses of fork length in wild cutthroat trout (Salmo clarki) in Berry Creek. A laboratory starvation experiment apparently confirmed the occurrence of this phenomenon in the species. The relation between loss of body length and its effect on the interpretation of condition factors and in estimates of biomass in fish populations are briefly discussed. (Authors)

18235. McLeay, D. J., and D. A. Brown (Div. of Applied Biol., B. C. Research, Vancouver, British Columbia, Canada). 1974. GROWTH STIMULATION AND BIOCHEMICAL CHANGES IN JUVENILE COHO SALMON (*Oncorhynchus kisutch*) EXPOSED TO BLEACHED KRAFT PULPMILL EFFLUENT FOR 200 DAYS. J. Fish. Res. Board Can., 31(6): 1043-1049.

Juvenile coho salmon were exposed for 200 days to neutralized, filtered bleached kraft mill effluent (BKME) at concentrations of 0.1 and 0.25 of the samples' 96-h LC50 values. From 50 to 200 days, mean weights of fish exposed to 0.25 LC50 BKME were significantly higher than control values; those of fish in 0.1 LC50 BKME were consistently but not significantly higher than control weights. By 200 days, mean weight of fish receiving the higher BKME concentration was twice that of controls. Length and condition factor of this group of fish were also increased. Growth results are considered in terms of BKME-induced behavioral changes, increased nutrient supply, effluent salinity, hormetic effects, and hormonal changes. Lactate levels were elevated in the blood and muscle of coho fry exposed to the higher BKME concentration only; serum pyruvate levels were decreased in fish receiving either concentration. The serum lactic acid:pyruvic acid ratio was increased in both groups of fish continuously exposed to BKME. It was concluded that these fish had developed an oxygen debt. Plasma glucose levels were elevated in BKME-exposed fish. The liver:muscle glycogen ratio was increased in fish held in 0.1 or 0.25 LC50 BKME for 200 days. Body moisture and lipid content were not altered by prolonged exposure to BKME. Body protein content was decreased in those exposed to 0.25 LC50 effluent. Total blood cell, erythrocyte, leukocyte-thrombocyte and differential leukocyte counts were not altered. Numbers of circulating neutrophils were increased by the higher effluent concentration. The chronic stress response pattern displayed was similar to a previously proposed stage of resistance to stress for mammals. (Authors)

18236. Klaassen, Harold E., and Kenneth L. Morgan (Div. of Biol., Kansas State Univ., Manhattan, Kansas 66506). 1974. AGE AND GROWTH OF LONGNOSE GAR IN TUTTLE CREEK RESERVOIR, KANSAS. Trans. Amer. Fish. Soc., 103(2): 402-405.

Age and growth of the longnose gar in Tuttle Creek Reservoir were studied. The 101 gars were aged from the branchiostegal rays. The fish length-branchiostegal length relationship was $L = 174.21 + 25.74 B$, where L = total fish length in mm and B = branchiostegal length in mm. Female gars grew faster than males. Growth increments for males for the first 6 years were 504.7, 123.7, 80.8, 48.6, 38.7, 22.8 mm; for females, for the first 8 years, 522.7, 164.1, 96.7, 64.5, 50.6, 59.7, 40.7, 20.7 mm. The length-weight relationship was $\log W = 6.426 + 3.274 \log L$, where W = weight in g and L = total length in mm. Growth of gars in Tuttle Creek Reservoir was greater than that reported in other areas. (Authors)

18237. Rinne, John N. (Dept. of Zool., and Lower Colorado River Basin Res. Lab., Arizona State Univ., Tempe, Arizona 85281). 1974. THE INTRODUCED ASIATIC CLAM, *Corbicula*, IN CENTRAL ARIZONA RESERVOIRS. The Nautilus, 88(2): 56-61.

Horizontal and vertical densities and biomasses of *Corbicula* in two central Arizona reservoirs were estimated employing meter square quadrats and Ekman dredge sampling. Concentrations of clams increased with depth of water and down-lake from inflow areas characterized by greater turbidity (suspended sediment). Densities were highest on rock-rubble slopes and increased directly with complexity (number of components) of substrate. Data suggest food supply, substrate, turbidity and perhaps fish predation as important factors in determining densities and biomasses of clams in the two reservoirs examined. (Auth.)

18238. Sharp, Thomas R. (Dept. of Fish., Humboldt State University, Arcata, California 95521). 1974. STANDING CROPS OF BENTHIC FAUNA IN MARINE AQUACULTURE PONDS USING RECLAIMED WATER. Environ. Protection Tech. Series, "Wastewater Use in the Production of Food and Fiber--Proceedings", EPA-660/2-74-041, pp. 513-528.

18239. Burdick, G. E., Howard J. Dean, Jack C. Skea, Charles N. Frisa (N. Y. State Dept. of Environ. Conservation, Albany, New York 12201). 1974. EFFECT OF BLACKFLY LARVICIDING IN SOME ADIRONDACK STREAMS. N. Y. Fish Game J., 21(1): 1-17.

The effect, on other stream arthropods, of aerial spraying with DDT and methoxychlor for blackfly control was studied on several Adirondack streams, primarily in the Schroon River watershed. Samples from the stream bottom were taken before and at intervals after treatment, and live individuals of the orders Plecoptera, Ephemeroptera, Trichoptera and Diptera were recorded and preserved. Similar data were taken for comparable untreated streams. Weight of the organisms collected was used as the basis of comparison. Weights varied widely, but there was an apparently direct relationship between the population by weight in early May (at the time the first post-treatment samples were taken) and that at later intervals during the season. Therefore, a procedure was devised for calculating, for a given stream in a given year, values for the later samples as percentages of the first sample which was considered to be 100. These percentages for the different streams could then be compared. The data showed that both DDT (as a 20 percent solution) and methoxychlor (as a 15 percent solution) had a significant effect on arthropods other than blackflies in the streams studied. Percentage overlap and Margalef's diversity index as means of assessing population are also discussed. (Authors)

18240. Anderson, R. Stewart (Dept. of the Environ., Canadian Wildl. Service, Biol. Dept., Univ. of Calgary, Calgary, Alberta, Canada). 1974. CRUSTACEAN PLANKTON COMMUNITIES OF 340 LAKES AND PONDS IN AND NEAR THE NATIONAL PARKS OF THE CANADIAN ROCKY MOUNTAINS. J. Fish. Res. Board Can., 31(5): 855-869.

The crustacean plankton communities of 340 lakes and ponds in southern Alberta and southeastern British Columbia were examined. The waters are situated between 660 m and 2455 m in elevation, have areas from < 0.1 to 3940 hectares, and range from 0.5 m to 136 m in depth. They represent a wide range of salinities, from 2 ppm to 29,800 ppm. The communities were grouped into seven main types on the basis of the copepod species present. Of the 97 crustacean species present, 32 were copepods, 50 were cladocerans, and 9 were anostracans. The three most common species accounted for over 25% of the total species occurrences. Only two species were present in more than half the total lakes and ponds. A few species seem to be restricted to highly saline waters, and a few to low salinities, but most inhabited a wide range of aquatic environments. The most frequently occurring and abundant species tolerate a wide range of conditions. These species are also characterized by up to a fivefold variation in generation time. Certain species having restricted distribution patterns appear to be limited by both the chemistry of the water and the heat content. Aspects of species distribution, ecology, and interspecific relationships are discussed. Auth.)

18241. Kluymans, J. H. F. M., and D. I. Zandee (Lab. of Chem. An. Physiol., State Univ., 40 Jan van Galenstraat, Utrecht, The Netherlands). 1974. LIPID METABOLISM IN THE NORTHERN PIKE (*Esox lucius* L.) - 3. IN VIVO INCORPORATION OF $1\text{-}^{14}\text{C}$ -ACETATE IN THE LIPIDS. Comp. Biochem. Physiol., 48(4B): 641-649.

The specific radioactivity of the total lipids isolated from different organs of the northern pike (*Esox lucius* L.) after injection of $\text{Na-}1\text{-}^{14}\text{C}$ -acetate showed the highest values in the liver and the gills. In the liver, radioactivity was found mainly in the fatty acids, while in the gills the greater part was present in the unsaponifiable lipids. The percentage incorporation of radioactivity in lipid classes did not change significantly from 2 to 24 hr after injection, but decreased in phospholipids and increased in triglycerides during shorter incubation times. The number of fatty acids labeled as well as the amount of radioactivity incorporated increased rapidly after $1\text{-}^{14}\text{C}$ -acetate injection. Virtually all fatty acids were labeled after 2 hr injection. (Authors)

18242. Shotts, Emmett B., Jr., and Richard Rimler (Coll. of Vet. Med., Univ. Georgia, Athens, Georgia 30601). 1973. MEDIUM FOR THE ISOLATION OF Aeromonas hydrophila. Applied Microbiol., 26(4): 550-553; Fish Health News, 3(3): p. 13.

A new differential medium, Rimler-Shotts, was tested with 109 isolates representing 13 genera of bacteria obtained from aquatic environments and animals. This medium was effective in presumptive identification of the strains of Aeromonas hydrophila examined, with 94% accuracy. Strains of Citrobacter which were hydrogen sulfide-variable could not be separated from A. hydrophila. This medium was designed to facilitate diagnosis of A. hydrophila infections in animals and humans. (Authors)

18243. Kawatski, J. A., V. K. Dawson, and M. L. Reuvers (Dept. of Biol., Viterbo Coll., La Crosse, Wisconsin 54601). 1974. EFFECT OF TFM AND BAYER 73 ON IN VIVO OXYGEN CONSUMPTION OF THE AQUATIC MIDGE Chironomus tentans. Trans. Amer. Fish. Soc., 103(3): 551-556.

Exposure of fourth instar larvae of Chironomus tentans to 2.0-8.0 mg/liter of TFM (3-trifluormethyl-4-nitrophenol) for 6 hr at 22 ± 0.5 C in soft water resulted in a significantly increased rate of larval oxygen consumption compared to that of control larvae, as measured with the Warburg respirometer. Maximum stimulation of oxygen consumption occurred with 8.0 mg/liter of TFM, and 1.0 mg/liter of TFM had no measurable effect on basal respiration. When hardness of exposure water was progressively increased, the effect of TFM on oxygen consumption was diminished. Bayer 73 (5,2'-dichloro-4'-nitrosalicylanilide) stimulated oxygen consumption at 0.75 and 1.0 mg/liter, had no significant effect at concentrations less than 0.75 mg/liter, and inhibited oxygen consumption at concentrations of 1.20 mg/liter or greater. Mixtures of TFM and Bayer 73, in the ratio of 98:2, had no greater effect on oxygen consumption than TFM alone. (Authors)

18244. Moore, Harry H., Frederick H. Dahl, and Aarne K. Lamsa (U.S. Fish and Wildl. Serv., Marquette, Michigan 49855). 1974. MOVEMENT AND RECAPTURE OF PARASITIC-PHASE SEA LAMPREYS (Petromyzon marinus) TAGGED IN THE ST. MARYS RIVER AND LAKES HURON AND MICHIGAN, 1963-67. Great Lakes Fishery Comm. Technical Report No. 27, 19 p.

Recoveries of 477 (11.8%) of 4,048 tagged parasitic-phase sea lampreys showed that lampreys moved extensively and that interchange between the Great Lakes was common. Of 93 recoveries from 2,265 tagged lampreys released below the navigation locks in the St. Marys River, 80 were in Lake Huron, 12 in Lake Superior, and 1 in Lake Erie; of 359 recaptures from 1,666 released in northern Lake Huron, 331 were in Lake Huron, 25 in Lake Michigan, and 3 in the St. Marys River; and of 25 recaptures from 117 released in Lake Michigan, 21 were in Lake Michigan and 4 in Lake Huron. Of the 477 sea lampreys recovered, 209 (44%) were captured more than 15 km from the locality of release; 42 had traveled 160-628 km (average, 275 km) before they were recaptured. Among recaptures from sea lampreys released in northern Lake Huron, 240 (67%) were recovered within 15 km of the release point in less than 50 days after release; only 12 were recaptured within this radius after 50 or more days of liberty. Probability of recapture was not influenced by size among sea lampreys longer than 205 mm (total length), but the lampreys recaptured at the greater distances from the tagging localities tended to be large. All of 34 lampreys recaptured more than 150 km from the point of release were longer than 254 mm (average, 418 mm) when tagged and 9 recaptured more than 300 km away were longer than 354 mm (average, 441 mm). Four sea lampreys 345-445 mm long when tagged in November or early December were recovered in mid-September of the following year, at least 2 months after the end of the normal spawning season. Suggested possible reasons for this unusual occurrence are the extension of the parasitic phase of the life cycle beyond the usual 12 to 20 months, late-season maturation of the gonads, disease, or deleterious effects of the tags. (Authors)

18245. Gillespie, D. C., T. P. T. Evelyn, C. Frantsi, R. M. MacKelvie, and N. Neufeld (Dept. of the Environ., Fisheries and Marine Serv., Freshwater Inst., Winnipeg, Manitoba, Canada). 1974. METHODS FOR THE DETECTION OF CERTAIN PATHOGENS OF SALMONID FISHES. Dept. of the Environ., Fish. and Mar. Serv., Ottawa, Canada, Misc. Special Publication No. 23, 19 p.

This manual of laboratory methods represents an integrated, step-by-step procedure for handling fish samples to test for the major bacterial, viral, and myxosporidian pathogens of salmonids. Except for certain situations involving the lethal sampling of wild spawners, the sampling procedures are based on the probability, at the 95% level of confidence, of detecting a disease agent carrier, assuming a certain prevalence of carriers in the population. Composition, transportation, and laboratory handling of the samples are described in detail. The methods provide for the detection of pathogens that are divided into two groups, based on degree of ubiquity. Pathogens in the more widespread or "notifiable" group are the myxobacteria, the motile aeromonads, the pseudomonads, and the vibrios; identification to the species level is not required for these organisms. Pathogens in the less ubiquitous or "certifiable" group are the kidney disease bacterium, the redmouth bacterium (Enterobacteriaceae), Haemophilus piscium, Aeromonas salmonicida, the protozoans Myxosoma cerebralis and Ceratomyxa shasta, and the viruses of hemorrhagic septicemia, infectious hematopoietic necrosis, and infectious pancreatic necrosis. In addition, any unidentified virus or virus-like agent, detected during the virological assays, is regarded as a certifiable agent unless its pathogenicity for salmonids has been disproven. (Authors)

18246. Fukushima, Masakazu, Seiichi Hayashi, and Zentaro Ooshiro (Fac. of Fisheries, Kagoshima Univ., Shimoaratacho, Kagoshima, Japan). 1974. STUDIES ON MYOKINASE IN THE MUSCLE OF FISHES - II. SOME PROPERTIES OF MYOKINASE ISOZYMES PURIFIED FROM MUSCLE OF CARP. Bull. Jap. Soc. Sci. Fish., 40(3): 299-302. In Japanese with English abstract.

Previously, the authors reported on the purification of myokinase I and II from the carp muscle by ammonium sulfate fractionation, Sephadex gel filtration, and by DEAE-cellulose and CM-cellulose column chromatography. In this paper, studies on some properties of these purified myokinase isozymes were reported. The molecular weights of myokinase I and II, determined both by gel filtration on Sephadex G-75 and by electrophoresis on SDS-polyacrylamide gel, were 27,000 and 22,000 respectively. Influences of pH and temperature on the transphosphorylation of ADP by these two isozymes were almost similar, and enzymatic reactions were ascertained to be optimally active at pH 7.5 and temperature 36-38°C. Carp myokinase isozymes were found to be specific for ADP, whereas they were ascertained not to transphosphorylate the following sorts of nucleoside-5'-diphosphate:GDP, IDP, CDP and UDP. These results show the extremely high specificity of the carp myokinase isozymes. (Authors)

18247. Ryck, Francis M., Jr., and James R. Whitley. 1974. POLLUTION ABATEMENT IN THE LEAD MINING DISTRICT OF MISSOURI. Presented at the 29th Purdue Industrial Waste Conf., Lafayette, Indiana, May 7-9, 1974, reprint 8 p. available from Missouri Dept. of Conservation, 1110 College Ave., Columbia, Missouri 65201.

The Missouri Department of Conservation has monitored water quality in Ozark streams affected by lead mining, milling, and smelting since 1965. Reductions in the number of types of pollution intolerant bottom dwelling macroinvertebrates and in diversity index values were the parameters monitored in this program. Typically, samples from unpolluted streams had diversity index values of at least 4.0 and eight or more total mayfly and stonefly taxa. Samples from polluted streams had reduced diversity index values and fewer than eight types of mayflies and stoneflies. In 1969, the St. Joe Minerals Corporation Viburnum Division began a 6-month trial of the effectiveness of mill effluent recycling in abating the pollution of Indian Creek. Permanent mill effluent recycling began in 1972 at the Viburnum Division. Mill effluent recycling at the Fletcher Division on Bee Fork was started in 1971. Recycling of mill effluent at both operations was effective in reducing the level of pollution in the receiving streams. Pollution abatement

at the AMAX Lead Company Buick Project involved lengthening the headwaters of Strother Creek by creating meanders below an existing tailings pond and a new 17-acre lake downstream from the meanders. These modifications resulted in noticeable increases in diversity values and decreases in undesirable growths of filamentous algae in the stream. (Authors).

18248. Slaney, P. A., and T. G. Northcote (Inst. of Animal Resource Ecol., Univ. of Brit. Columbia, Vancouver, British Columbia V6T 1W5, Canada). 1974. EFFECTS OF PREY ABUNDANCE ON DENSITY AND TERRITORIAL BEHAVIOR OF YOUNG RAINBOW TROUT (Salmo gairdneri) IN LABORATORY STREAM CHANNELS. J. Fish. Res. Board Can., 31(7): 1201-1209.

When rainbow trout (Salmo gairdneri) fry (underyearlings) were introduced into laboratory channels at three different prey levels and permitted to emigrate voluntarily, their density remained highest at the highest prey level. The distribution of fry was positively associated with a gradient in prey abundance. Both territory size and frequency of aggressive encounter varied inversely with prey level; the higher the prey level, the smaller the territory and the lower the frequency of aggressive encounter. Emigration from the channels was neither as rapid nor as marked when prey level was reduced, compared to when fry were initially introduced to different prey levels. However, frequency of aggressive encounter significantly increased when the prey level was decreased and significantly decreased when the prey was increased. (Authors)

18249. Leadem, Timothy P., Roger D. Campbell, and Donald W. Johnson (Biol. Dept., Idaho State Univ., Pocatello, Idaho 83201). 1974. OSMOREGULATORY RESPONSES TO DDT AND VARYING SALINITIES IN Salmo gairdneri - I. GILL Na-K-ATPase. Comp. Biochem. Physiol., 49(1A): 197-205.

DDT inhibited activity of Na-K-ATPase and Mg-ATPase in gills of rainbow trout (Salmo gairdneri) adapted to fresh water (FW), 1/3 sea water (1/3 SW) and SW. A negative correlation was found between gill Na-K-ATPase (decrease) and serum sodium (increase) in treated fish in SW. Enzyme activity was inhibited in FW fish, but no osmoregulatory impairment was found. This may indicate a minor or nonexistent role for gill Na-K-ATPase in FW osmoregulation. Enzyme activity was inhibited in trout acclimated to SW ($SW > 1/3 SW > FW$). (Authors)

18250. deVlaming, Victor L. (Dept. of Biol., Marquette Univ., Milwaukee, Wisconsin 53233). 1974. ENVIRONMENTAL AND ENDOCRINE CONTROL OF TELEOST REPRODUCTION. In: Control of Sex in Fishes, C. B. Schreck, ed. Sea Grant and V.P.I. & S.U. Press, VPI-SG-74-01:13-83.

Both environmental and hormonal factors are extremely important in regulating reproductive cycling in teleosts. Various central mechanisms translate environmental cues into chemical messengers which function to activate and maintain the reproductive organs. In this regard, the functional relationship between the hypothalamus and pituitary gland is important, and the pineal gland plays a possible role in regulating sexual maturation. The pituitary has a central role in controlling gonadal activity, and there are recent developments concerning identification, morphological characteristics and functional changes in pituitary gonadotropic cells. Recent research on purification of teleost pituitary gonadotropic hormones is important in implicating these hormones in gametogenesis and gonadal sex steroid production. The sex steroids also play a possible role in gametogenesis and are involved in development of secondary sexual characters. Other endocrine glands and hormones have also been implicated in influencing gonadal function. (Auth.)

18251. Jones, Barry C., and Glen H. Geen (Dept. of Biol. Sci., Simon Fraser Univ., Burnaby 2, British Columbia, Canada). 1974. SMALL SHARK RESTRAINING APPARATUS. Prog. Fish-Cult., 36(2): 115.

An apparatus consisting of a padded, angular cradle with completely adjustable straps is described on which sharks up to 1.25 meters in length can be safely, securely, and easily restrained and examined by one person in minimum time. (Authors)

18252. Koch, Henri J. A. (Zool. Inst., Univ. of Leuven-Louvain, B-3000, Belgium). 1973. THE SHIFT IN THE PROPORTION OF THE HAEMOGLOBINS DURING THE GROWTH OF *Salmo salar* L. International Atlantic Salmon Symposium 1972, Special Publication Series, 4(1): 111-117.

During the whole post-embryonic ontogeny two groups of haemoglobin components coexist in *Salmo salar* (L.). The ratio between these two groups of components (as determined by densitometry on micro starch gel electropherograms) varies with the size of the specimens to reach in sexually mature animals a nearly 1:1 ratio. In growing post smolts a difference in the rate of change of the ratio of the two groups of components has been observed between landlocked salmon of Lake Vänern and salmon from Baltic stock, both being kept in fresh water, and salmon of Norwegian origin living in full sea water. In sexually mature specimens, all living in fresh water, a difference in the ratio persists between one of the landlocked Vänern strains and different ocean-running strains, and also the Baltic strain. The possible biological significance of these differences is briefly discussed. (Auth.)

18253. Fenwick, James C. (Dept. of Biol., Univ. of Ottawa, Ottawa K1N 6N5, Canada). 1974. THE COMPARATIVE IN VITRO RELEASE OF CALCIUM FROM DRIED AND DEFATTED EEL AND RAT BONE FRAGMENTS, AND ITS POSSIBLE SIGNIFICANCE TO CALCIUM HOMEOSTASIS IN TELEOSTS. Can. J. Zool., 52(6): 755-764.

The in vitro release of calcium from dried and defatted fragments of eel bone and rat bone was examined in a number of inorganic solvents and in eel and rat plasma. In each inorganic solvent, the rate of withdrawal of calcium from eel bone exceeded the rate of withdrawal from rat bone; and at equilibrium, the eel bone supported a higher solvent-calcium concentration than did the rat bone. In eel plasma, fragments of eel bone supported a plasma calcium concentration greater than the concentration of calcium in normal plasma in vivo. These results are consistent with the view that in normal eels, the plasma is undersaturated with calcium with respect to the simple solubility of bone calcium. The hypothesis that the simple solubility of bone calcium plays a greater role in the maintenance of calcium homeostasis in fishes than it does in mammals is discussed in relation to the observations made. (Auth.)

18254. Contos, Nicholas, and Hans Rothenbacher (Dept. of Vet. Sci., The Pennsylvania State University, University Park, Pennsylvania 16802). 1974. AN EFFICIENT CONCENTRATION AND PURIFICATION METHOD FOR SPORES OF *Myxosoma cerebralis*. Prog. Fish-Cult., 36(2): 101-102.

Myxosoma cerebralis spores were recovered from infected trout in highly concentrated and debris-free suspensions. This relatively fast and simple concentration method can supply spore suspensions that would be suitable for diagnosis of carrier fish, fish with light or early infections, or many experimental applications which require large numbers and high purity. Skulls and spines were homogenized in a Waring blender and chemically digested in an acid-pepsin solution for 3-6 hrs. The digested homogenate was passed through a 72 μ opening sieve to remove any larger or undigested particles. The spores were pelleted by centrifugation at 1,000 xg, resuspended in distilled water, and mixed vigorously with ethyl ether. After centrifugation at 200 xg, the spores were found pelleted in the water phase below and the remaining particulate debris and fatty contaminants were found in the ether phase above or in the water-ether interface. The ether phase and the water-ether interface were drawn off and the pellet of pure white spores was resuspended and washed in several changes of distilled water. Finally, the spores were suspended in a known volume of distilled water and counted in a hemacytometer chamber. The yield was approximately 2×10^6 visibly intact spores from each 4-6 in. fish. Little or no debris was ever observed in spore suspensions examined microscopically. Spores were treated with 200 μ /ml penicillin and 200 μ g/ml streptomycin and stored at 4°C. (Authors)

18255. Hoffman, G. L., E. V. Raikova, and W. G. Yoder (Eastern Fish Disease Lab., Kearneysville, West Virginia 25430). 1974. *Polypodium* sp.(COELENTERATA) FOUND IN NORTH AMERICAN STURGEON. J. Parasitol., 60(3): 548-550.

18256. McAllister, P. E., J. L. Fryer, and K. S. Pilcher (Dept. of Microbiol., Oregon State Univ., Corvallis, Oregon 97331). 1974. FURTHER CHARACTERIZATION OF INFECTIOUS HEMATOPOIETIC NECROSIS VIRUS OF SALMONID FISH (OREGON STRAIN). Arch. Gesamte Virusforsch., 44, pp. 270-279.

The replication cycle of the infectious hematopoietic necrosis virus of salmonids was studied in cultures of a salmon cell line by constructing a single cycle growth curve. New infectious virus was beginning to appear by the fourth hour of incubation at 18°C, and continued to increase in concentration until the twentieth hour. Further evidence that the cytoplasm is the site of capsid assembly was obtained by the use of fluorescent antibody. Viral antigen was detectable in the cytoplasm after two hours incubation, and increased progressively in amount during the next four hours. No antigen was detected in cell nuclei. The synthesis of viral RNA was monitored in infected cultures. It increased at a fairly constant rate from the eighth to the seventeenth hour of incubation, in good agreement with the single cycle growth curve for virus. Quantitative data on thermal stability of the virus indicated a rapid loss of infectivity in aqueous suspension at room temperature, and even more rapid deterioration in a balanced saline solution. (Authors' summ.)

18257. Hynes, H. B. N., N. K. Kaushik, M. A. Lock, D. L. Lush, Z. S. J. Stocker, R. R. Wallace, and D. D. Williams (Dept. of Biol., Univ. of Waterloo, Waterloo, Ontario, Canada). 1974. BENTHOS AND ALLOCHTHONOUS ORGANIC MATTER IN STREAMS. J. Fish. Res. Board Can., 31(5): 545-553.

Investigations into the vertical distribution of stream animals by means of a coring technique have demonstrated that they could be found many decimeters down in the gravel; a maximum of 17% was found in the top 5 cm. Sampling of arctic streams revealed that chironomid larvae comprised 70-80% of the numbers in the benthos and that their rate of drift did not vary with the time of day. Life history studies of stream invertebrates have demonstrated clear seasonal patterns in Canada. Work has been done on several mayflies and stone flies, some Chironomidae, and two species of Gammarus. Currently the life histories of the stone flies of southern Australia are being investigated in which the seasonality is much less marked. After the experimental application of the blackfly larvicide Methoxychlor to two rivers, a catastrophic drift of invertebrates occurred and larvicide residues were detected up to 8 wk after application. Work on the decomposition of autumn-shed leaves in water has included the responses to temperature and to additional nutrients (N and P). The effect of nutrient addition was to increase the amount of nitrogen in the leaf after incubation, but temperature affected only the rate of decomposition. Determination of the relative importance of bacteria and fungi in decomposition, was studied with use of antibiotics, and food preference of Gammarus for several leaf species was determined. A considerable portion (up to 40%) of the autumn-shed leaf is water-soluble, and the way in which it is made available to stream animals was investigated. One process, its conversion into particles, appears to involve mechanisms similar to those found in soils, i.e. by formation of organic/metal complexes. Using infrared spectroscopy, attempts have been made to characterize the laboratory and field-produced particles. Field investigations have also demonstrated large-scale fluctuations, during only a few hours, of dissolved and particulate organic matter in the water. These findings are considered in relation to general stream ecology. (Authors)

18258. Kynard, Boyd (Arizona Coop. Fish. Unit, The Univ. of Arizona, Tucson, Arizona 85721). 1974. AVOIDANCE BEHAVIOR OF INSECTICIDE SUSCEPTIBLE AND RESISTANT POPULATIONS OF MOSQUITOFISH TO FOUR INSECTICIDES. Trans. Amer. Fish. Soc., 103(3): 557-561.

Mosquitofish, Gambusia affinis, from two populations differing greatly in insecticide tolerance were tested for their ability to avoid concentrations of DDT, endrin, toxaphene and parathion in a Y-maze. Both susceptible and resistant fish avoided endrin, toxaphene, and parathion. DDT was avoided by susceptible fish but not by resistant fish. Resistant fish avoided damaging concentrations (except DDT) better than did susceptible fish. (Auth.)

18259. MacCrimmon, H. R., J. E. Stewart, and J. R. Brett (Dept. of Zool., Univ. of Guelph, Guelph, Ontario, Canada). 1974. AQUACULTURE IN CANADA. THE PRACTICE AND THE PROMISE. Dept. of the Environ., Bull. Fish. Res. Board Can., 188: 84 p.

Some forms of aquaculture have existed in Canada for many years on a small scale. This Bulletin reviews the current practices and identifies opportunities for establishing a substantial and viable industry based upon freshwater fisheries, marine fishes, and invertebrates. It focuses on the scientific and technical basis for such an industry and on the constraints to be encountered, and identifies areas that need experimental development to provide pilot-scale production data and economic assessments. (Authors)

18260. Orme, Leo E., and Carol A. Lemm (U.S. Fish & Wildl. Serv., Spearfish Fisheries Center, Spearfish, South Dakota 57783). 1974. USE OF DRIED SLUDGE FROM PAPER PROCESSING WASTES IN TROUT DIETS. Amer. Fishes and U.S. Trout News 19(2): 17-19; NOAA Marine Fisheries Abstracts, 27(8): 3.

A 285-day feeding trial was carried out with rainbow trout to determine the acceptability in the diet of dried sludge from paper processing wastes. The dried sludge was used at 25% and 50% levels in the test diets. The amounts of ingredients in the control diet and in the two test diets were adjusted to achieve protein levels of 40% and fat levels of 9%. The ash and fiber contents of the three diets were different, and no attempt was made to balance them out. The dried ground sludge was odorless, light tan in color, and consisted of: crude protein, 42.3%; crude fat, 0.43%; ash, 27.69%; fiber, 10.6%; moisture, 3.03%; and NFA (nonfat extractables), 16.0% (by difference). Bacteriological analysis indicated that the dried sludge was free of pathogenic bacteria. The three diets, control, test diet 1, and test diet 2, contained 32%, 20%, and 15% herring meal and 0%, 25%, and 50% dried sludge, respectively. Apparently the sludge was palatable to the trout because they fed aggressively on all three diets. Feed conversions for the fish on the control diet, test diet 1, and test diet 2 were 1.45, 1.58 and 1.72, and growth rates (wt. gain per day) were 18.2%, 13.7%, and 12.1%, respectively. The mortality rate was low and about the same in all three groups.

18261. Donaldson, Edward M., and J. R. McBride (Dept. of the Environ., Fish. and Marine Serv., Vancouver Lab., Vancouver, British Columbia V9R 5K6 Canada). 1974. EFFECT OF ACTH AND SALMON GONADOTROPIN ON INTERRENAL AND THYROID ACTIVITY OF GONADECTOMIZED ADULT SOCKEYE SALMON (*Oncorhynchus nerka*). J. Fish. Res. Board Can., 31(7): 1211-1214.

Injection of a chinook salmon (*Oncorhynchus tshawytscha*) gonadotropin preparation into gonadectomized sockeye salmon (*Oncorhynchus nerka*) did not result in any increase in the plasma concentration of cortisol or cortisone, nor did it stimulate the activity of the interrenal tissue. On the other hand, injection of mammalian ACTH (Acthar) did result in an increase in the plasma concentration of cortisol and cortisone, and stimulated the interrenal tissue. The salmon gonadotropin preparation, however, elicited an increase in thyroid activity. The results suggest that in the salmon, ovulation is not caused by gonadotropin induced interrenal corticosteroidogenesis. (Authors)

18262. Jackson, Bonnie J. (N. Y. State Dept. of Environ. Conserv., Albany, New York 12201). 1974. STREAM BED STABILIZATION IN ENFIELD CREEK, NEW YORK. N. Y. Fish and Game Journal, 21(1):32-46.

This study was undertaken to observe the performance of bed sills, in stabilizing a high-gradient trout stream subjected to severe headcutting. Gabion structures were installed in Enfield Creek (N. Y.) in 1967. A topographical survey of the stream bed was made prior to installation and in 1968, 1970, 1971 and 1973. The sills were immediately effective in arresting headcutting and in accumulating gravel material, and they had a distinct stabilizing effect for almost 0.8 mile downstream. Gabion construction is discussed, and a theory for partial failure of the two lower sills during the June 1972 flood is postulated. (Auth.)

18263. Wachs, B. (Bayer. Biologischen Versuchsanstalt München, Germany). 1973. EXPERIMENTALLY PRODUCED SYMPTOMS OF ULCERATIVE DERMAL NECROSIS (UDN) IN BROWN TROUT. [Bei Bachforellen experimentall erzeugte Symptome der geschwürigen Hautnekrose (UDN)]. Wasser und Abwasser-Forschung, No. 5, 153-159; Fish Health News, 3(3): p. 15.

The so-called UDN (Ulcerative Dermal-Necrosis) of adult salmonids is a skin disease with fungus infection. Some experiments have been carried out in the laboratory for studying the influence of waste waters on the skin of brown trouts. In aquaria dilutions were made from iron-containing water of a shutdown mine and of mechanically treated sewage from the town of Munich. The results of these experiments indicate that the symptoms of UDN can be caused experimentally by substances in waste waters. A connection between the disease, with its grey-white spots, lesions of necrosis and ulceration of the epidermis covered by a layer of fungus, and pollution of rivers, has been established. (Auth.)

18264. Moyle, Peter B., and Robert D. Nichols (Dept. of Biol., California State Univ., Fresno, California 92710). 1974. DECLINE OF THE NATIVE FISH FAUNA OF THE SIERRA NEVADA FOOTHILLS, CENTRAL CALIFORNIA. Amer. Midl. Nat., 92(1): 72-83.

A survey was made of the fishes occurring in streams of the Sierra Nevada foothills above the San Joaquin Valley, California. Twenty-four species were collected, 12 native, 12 introduced. The present distributions of these fishes were compared to their pre-1900 distributions, as inferred from old records. Overall, the ranges of introduced species and rainbow trout have expanded while the ranges of native species, especially California roach, hardhead, Sacramento squawfish and Sacramento sucker, have contracted. Healthy populations of native fishes were found only in a rather narrow middle elevation band of comparatively undisturbed sections of foothill streams, the native fish populations in different foothill stream systems are now isolated from each other and are, thus, in danger of local extinction as foothill development proceeds. The study indicates that populations of native stream fishes, even if they do not contain endangered species, should be protected to make sure that severe natural conditions, when combined with human alterations of the streams, do not destroy unique assemblages of fishes. (Authors)

18265. Jeffries, H. Perry, and William C. Johnson (Grad. School of Oceanogr., Univ. of Rhode Island, Kingston, Rhode Island 02881). 1974. SEASONAL DISTRIBUTIONS OF BOTTOM FISHES IN THE NARRAGANSETT BAY AREA: SEVEN-YEAR VARIATIONS IN THE ABUNDANCE OF WINTER FLOUNDER (Pseudopleuronectes americanus). J. Fish. Res. Board Can., 31(6): 1057-1066.

Weekly bottom trawl samples taken in Narragansett Bay and Rhode Island Sound from January 1966 through December 1972 showed patterns of occurrence within a diverse assemblage of migratory and resident stocks. Relative abundance of winter flounder (Pseudopleuronectes americanus), the commonest species in the Bay, appeared to be associated with climatic trends but not with fishing pressure. Catch decreased 78% from 1968 to 1972. Average temperature during 30-mo periods, the time required for flounder to reach catchable size, explained 76% of variation in abundance through the study. Annual abundance in the Bay is also reflected 2-3 yr later in the commercial catch. A speculative explanation for control of the population in an estuarine nursery is developed, based on subtle climatic trends whose effects have been magnified many times over by competitive processes among migratory populations. The sand flounder (Scophthalmus aquosus), second in general abundance, varied far less than the winter flounder. Catches of the lobster (Homarus americanus) and winter flounder were directly related, both on a monthly as well as yearly basis. The remaining species of numerical importance appeared to avoid peak abundances of one another in the Bay and Sound; rarely did seasonal maxima of two or more species occur during the same month. (Authors)

18266. Larsen, Peter F. (Virginia Inst. of Mar. Sci., Gloucester Point, Virginia 23062). 1974. A REMOTELY OPERATED SHALLOW WATER BENTHIC SUCTION SAMPLER. Chesapeake Science, 15(3): 176-178.

18267. Hirata, Hachiro (Lab. of Propagation Physiol., Fac. of Fish., Kagoshima Univ., Kagoshima, Japan). 1973. DIURNAL RHYTHM OF METABOLIC AND ACTIVITY RATES IN JUVENILE ATLANTIC SALMON, Salmo salar Linnaeus. Mem. Fac. Fish., Kagoshima Univ., 22(1): 73-93. In English.

The experiments on the diurnal rhythm in young Atlantic salmon were carried out in the hatchery during September to February. The oxygen consumptions of three fish were measured at several times (2 a.m., 8 a.m., 2 p.m., 8 p.m.) by modified Tamura's method under the conditions of 'control', 'light', '12-hour' and '6-hour'. Rates of feeding (ten fish) and movement (three fish) were recorded with simple feeding recorder and actograph under just 'control' condition. Each experiment lasted for four or five days. Temperature and oxygen content in the water were kept almost constant during each experiment. In the cases of oxygen consumption, considerable fluctuations ('control', '12-hour' '6-hour') or decreases ('light', 'dark') of the rates are observed during the first one or two days of each experiment. Later, the fluctuations or decreases become to be a regular ('control', '12-hour', '6-hour') or no rhythm ('light', 'dark'). From the events, it is considered that the fish take one or two days to adapt to the experimental condition due to the physiological fatigue. The rate of oxygen consumption in the 'control' shows a variation that may be related to day and night. Higher rates of consumption show in the daytime, generally, and lower rates were seen during the nighttime. On the contrary, there is no diurnal rhythm in the cases of continuous light and dark conditions. After two or three days, the rates of oxygen consumption in the cases of alternating every 12-hour and 6-hour depend upon the light-on or -off, and show 24-hour-rhythm and 12-hour-rhythm, respectively. It is to be presumed from the results that the daily variation of the rate of oxygen consumption shows an exogenous rhythm from those which are under the control of light factor. The rates of feeding and movement show a diurnal rhythm like a rate of oxygen consumption. Only one point of difference between oxygen consumption and both feeding and movement is generally found in the time of their peak occurrence. That is, the peak of rate of oxygen consumption occurs at 2 p.m. while the peaks of both feeding and movement occur in the morning on the whole. It is to be considered that the maximum rate of oxygen consumption is due to the specific dynamic action (SDA) which occurred a few hours after their feeding and caused by the food digestion. Daily amount of oxygen consumed is influenced by different light duration. In the control, average amount of oxygen consumed was 92.8 ± 9.8 ml/kg/hr, and was the greatest among the conditions. The lowest rate of oxygen consumption was found in the case of continuous dark condition (51.5 ml/kg/hr). The coefficient of daily variation of the amount is divided into two categories. That is, the first category contains control, 12-hour and 6-hour. The second category contains dark and light conditions. When compared with the decreasing rate of oxygen consumption for the first two days in each experiment, the first category shows gradual decreases while the second category shows sharper decrease. Therefore, continuous light or dark condition caused more injurious influence on the oxygen consumption than under the alternating condition. (Auth.'s summ.)

18268. Wehr, Larry W., and William M. Lewis (Fish. Res. Lab. and Dept. of Zool., Southern Illinois Univ., Carbondale, Illinois 62901). 1974. AN ELECTRICALLY OPERATED AUTOMATIC FISH FEEDER. Prog. Fish-Cult., 36(2): 117-118.

The design for an electrically operated automatic fish feeder is described. The feeder consists of a hopper, under which is positioned a trough containing an auger operated by a low rpm gearmotor. The gearmotor is activated by a timer. Feeding rates are given for four different designs of feeders. (Authors)

18269. Chandler, Jack H., Jr., Herman O. Sanders, and David F. Walsh (Southeastern Fish Control Lab., U. S. Fish and Wildlife Serv., Warm Springs, Georgia 31830). 1974. AN IMPROVED CHEMICAL DELIVERY APPARATUS FOR USE IN INTERMITTENT-FLOW BIOASSAYS. Bull. Environ. Contam. Toxicol., 12(1): 123-128.

18270. Fijan, N., and Z. Petrinc (Zavod za Biologiju riba i pcela Veterinarski Fakultet Sveucilista, 41001 Zagreb, Heinzelova 55, p.p. 190, Yugoslavia). 1973. MORTALITY IN A POND CAUSED BY CARP ERYTHRODERMATITIS. Riv. It. Piscic. Ittiop., 8(2): 45-49.

Carp dying with symptoms of infectious dropsy (IDC) in a pond were examined for the presence of the causal agent of carp erythrodermatitis (CE). Virological examination for SVC virus (*Rhabdovirus carpio*) gave a negative result. Inoculation of experimental carp with the material from the skin and internal organs of sick fish proved the disease to be caused by the organism having the characteristics of the CE agent. These results indicate the possibility of distinguishing CE from SVC on the basis of the criteria known at present. Moribund and dead fish from the epizooty had necrotic areas surrounded by hemorrhagic inflammation on fins and on other parts of the body, anemia, a very pronounced hydropsy with exophthalmia, lepidorthosis, bullae on skin, ascites and edema of all organs, as well as petechial bleedings in oral cavity and on arterial bulb. In experimentally infected carp the disease started as hemorrhagic inflammation of skin leading to necroses. Experimental fish in the premortal stage had the same but somewhat less pronounced symptoms as the carp from the pond. According to some data in the literature, symptoms in fish from this epizooty are characteristic for the acute form of IDC, and according to others they are typical for the subacute form of the same disease. Since we consider this mortality to be caused by CE, it is evident that CE does not represent a synonymous term for the chronic form of IDC. At the same time, the disease that has the characteristics of the acute form of IDC may not always be of viral etiology, i.e. it is not always identical to SVC. Epizootiological data and pathoanatomical findings indicated the outbreak of the disease to be caused by mechanical injuries (during netting and transportation) and by their simultaneous infection with the CE agent. The unfavorable course of CE and its mostly lethal outcome in the described case was probably caused by temperature conditions, stress and eventually some other factors. (Authors' summ.)

18271. Schreck, Carl B. (Dept. of Fish. and Wildl. Sciences, Virginia Polytech. Inst. and State Univ., Blacksburg, Virginia 24061). 1974. HORMONAL TREATMENT AND SEX MANIPULATION IN FISHES. In: Control of Sex in Fishes, C. B. Schreck, ed. Sea Grant and V.P.I. & S.U. Press, VPI-SG-74-01: 84-106.

Sex hormones have been used extensively in experiments dealing with sex reversal in fishes. Androgens and estrogens may cause genetic females and genetic males, respectively, to differentiate into functional, fertile adults of the heterologous sex. Gestagens and corticoids are ineffective as sex reversal agents. Unisexual populations of fish have broad management potential, including such areas as population control and weed eradication. (Auth.)

18272. Power, G. (Dept. of Biol., Univ. of Waterloo, Waterloo, Ontario, Canada N2L 3G1). 1973. ESTIMATES OF AGE, GROWTH, STANDING CROP AND PRODUCTION OF SALMONIDS IN SOME NORTH NORWEGIAN RIVERS AND STREAMS. Inst. of Freshwater Research, Drottningholm, Report No. 53, pp. 78-111.

Collections containing over 8,000 specimens of char, salmon parr and trout obtained by use of rotenone in Langvikelva, Troldeleva, Komagelva, Storelva, Russelva, Strupskareleva, Breivikelva and Leirskareleva are described. Species were generally segregated with char occupying headwaters and cold streams, trout warmer tributaries and downstream parts of rivers too small for salmon and salmon the lower reaches of rivers. Growth of all species was similar in all waters. Annual increments averaged 30 mm. Char fry emerged earliest and the slight advantage in size they attain during the first summer was maintained throughout the first 4-6 years of life. Most salmon parr migrate to sea during their fourth or fifth summers. Standing crops were as low as 9 g/100 sq.m. in glacial rivers with unstable beds but can be as high as 800 g/100 sq.m. in narrow favorable streams. Annual estimates of salmonid production ranged from 10 to 614 g/100 sq.m./year with a mean for 39 estimates of 150 g/100 sq.m./year and a median of 116 g/100 sq.m./year. A method for calculating estimated production in north Norway by use of habitat adjustment factors is described. (Auth.'s summ.)

18273. Malevski, Y., M. W. Montgomery, and R. O. Sinnhuber (Dept. of Food Sci. and Technology, Oregon State Univ., Corvallis, Oregon 97331). 1974. LIVER FAT AND PROTEIN METABOLISM IN RAINBOW TROUT (Salmo gairdneri) FED CYCLOPROPENOID FATTY ACIDS. J. Fish. Res. Board Can., 31(6): 1093-1100.

Effects of cyclopropenoid fatty acid (CPFA) ingestion on fat and protein metabolism in the liver of rainbow trout (Salmo gairdneri) were studied. Three dietary regimens were used: experimental group fed 0.5 mg CPFA/kg body weight per day, pair-fed control, and ad lib. control. CPFA ingestion did not cause a reduction in body weight gain; however, the ratio of liver weight to body weight was elevated. Livers of CPFA-fed trout had higher fat and lower protein levels. Incorporation of ^{14}C labelled amino acids into livers was reduced in CPFA-fed trout. Of the amino acids incorporated into the livers, a higher proportion was found in the liver proteins of CPFA-fed trout than pair-fed controls. The percentage of ^{14}C labelled acetate incorporation into liver fat of CPFA-fed trout was similar to that of the pair-fed controls, whereas acetate incorporation into liver proteins was reduced. Activities of glutamate dehydrogenase (EC 1.4.1.3) and alanine aminotransferase (EC 2.6.1.2) were lower in CPFA-fed trout after 36 days on the diet; acetyl-CoA carboxylase (EC 6.4.1.2) activity was unaffected by the treatment. (Authors)

18274. Fava, James A., Jr., and Chu-fa Tsai (Dept. of For., Fish. and Wildl., Nat. Res. Inst., Univ. of Maryland, College Park, Maryland 20742). 1974. THE LIFE HISTORY OF THE PEARL DACE, Semotilus margarita, IN MARYLAND. Chesapeake Science, 15(3): 159-162.

The life history of the pearl dace, Semotilus margarita (Cope), was studied in Hamilton Run, a tributary to Antietam Creek, Washington County, Maryland, from August 1970 to July 1971. The length-weight relationship yielded the equation, $W = 0.0000117 L^{3.251}$. The sex ratio of all the fish collected over one year was 2.00:1.00 (male:female), however, the sex ratio changed monthly. The females lived to age IV, whereas the males lived to age III. There was no difference in growth rate in length between males and females in age 0 fish, but, the females grew faster than the males in age I fish. Both males and females reached sexual maturity at the end of age I. The maturation process of gonads began in July and a maximum was reached in mid-April. Spawning occurred from late April to early June. The relationship between the number of eggs in the right ovary and standard length yielded the equation, $F = 0.68 L^{2.59}$. (Authors)

18275. de Kinkelin, P., and M. Le Berre. 1974. RHABDOVIRUS OF FISH. II. In vitro PROPERTIES OF THE VIRUS OF SPRING VIREMIA OF THE CARP. (Rhabdovirus des poissons. II. Propriétés in vitro du virus de la viremie printanière de la carpe.) Ann. Microbiol. (Inst. Pasteur) 125 A: 113-124; Fish Health News, 3(3): p. 10.

Spring viraemia of carp (SVC) virus is grown in fathead minnow (FHM) and titre averaging 10^8 P.F.U./ml are observed. Good yields are obtained in Epithelioma papulosum carpio (EPC) and, at a lower level, in brown bullhead (BB). One step infections in FHM cells demonstrate that good replication occurs between 10°C and 25° (optimum 21°) the only difference being in speed. Actinomycin D does not act on SVC production. Virus growth does not induce interferon in FHM and is little sensitive to its action. The metabolism of infected cells synthesis is decreased. SVC virus can be stored either frozen or lyophilized in medium containing 2% serum. Infectivity is stable in medium at 4° and very readily inactivated in water at 14° (90% within 3 days). For 15 minutes, heating at 45° or storage at pH 3 destroys respectively 99% and 99.9% of infectivity. SVC virus is serologically distinct from the other fish rhabdoviruses. It can be differentiated from pike rhabdovirus by its lower stability yield and lack of autointerference in FHM. (Authors)

18276. Hackney, P. A. (Div. of Fish. and Wildl. Mgmt., The Ohio State Univ., Columbus, Ohio 43210). 1974. ON THE THEORY OF FISH DENSITY. Prog. Fish-Cult., 36(2): 66-71.

18277. Nebeker, Alan V., Frank A. Puglisi, and David L. DeFoe (U.S. Environ. Protection Agency, Natl Water Qual. Lab., 6201 Congdon Blvd, Duluth, Minnesota 55804). 1974. EFFECT OF POLYCHLORINATED BIPHENYL COMPOUNDS ON SURVIVAL AND REPRODUCTION OF THE FATHEAD MINNOW AND FLAGFISH. Trans. Amer. Fish. Soc., 103(3): 562-568.

Two 9-month continuous-flow bioassays and several intermediate length continuous-flow tests were conducted to determine safe levels of Aroclor 1242, 1248, and 1254 for the fathead minnow (*Pimephales promelas*) and Aroclor 1248 for the flagfish, *Jordanella floridae*. Calculated 96-hr LC50 values for newly hatched fathead minnows were 7.7 µg/liter for Aroclor 1254 and 15 µg/liter for 1242. Three-month-old fatheads had a 96-hr LC50 of 300 µg/liter for 1242. Reproduction occurred at and below 1.8 µg/liter 1254 and at and below 5.4 µg/liter 1242. Newly hatched young were the most sensitive life stage. Growth of young fatheads was also affected above 2.2 µg/liter 1248, and none survived above 5.1 µg/liter after 30 days. Young flagfish did not survive at 1248 concentrations above 5.1 µg/liter and did not grow well above 2.2 µg/liter. Tissue residues in fathead minnows ranged from 0.7 µg/g 1248 in control fish to 1036 µg/g 1254 in fish held for 8 months in water containing 4.6 µg/liter 1254. (Authors)

18278. Windell, John T., Ronald Armstrong, and James R. Clinebell (Lab. of Animal Physiol. and Behavior, Univ. of Colorado, Boulder, Colorado 80302). 1974. SUBSTITUTION OF BREWER'S SINGLE CELL PROTEIN INTO PELLETTED FISH FEED. Feedstuffs, 46(20): 22-23; NOAA Mar. Fish. Abstracts, 27(8): p. 3.

Brewer's single cell protein (BSCP) consists mostly of the cells of microorganisms grown on the waste from the brewing industry. The finely-ground dried BSCP is reddish-gray and has a pleasant brewery aroma. In this study a 140-day feeding trial was conducted with rainbow trout to determine if BSCP could serve as a supplemental source of protein in pelleted fish feed by replacing certain ingredients in each of three test diets. The three test diets were prepared with 10% (diet 1), 15% (diet 2), and 50% (diet 3) of BSCP mixed with 8% pure corn oil. In diet 1, BSCP replaced 10% brewer's yeast; in diet 2, BSCP replaced 10% condensed fish solubles and 5% wheat germ; and in diet 3, BSCP replaced 15% herring meal, 10% brewer's yeast, 10% condensed fish solubles, 8% wheat middlings, 5% wheat germ, and 2% blood flour. The control diet was the standard Colorado 1/8-inch pellet feed. The proximate composition of the BSCP was crude protein, 44.4%; crude fat, 8.0%; ash, 12.6%; and moisture, 5.0%. Amino-acid analysis of the BSCP indicated that nine of the ten essential amino acids for trout and salmon are present and seven of these are present at levels that exceed minimum requirements. There appeared to be no difference in palatability between the control diet and test diet 1 (10% BSCP) and diet 2 (15% BSCP). The fish in these groups showed good growth and low mortality. The fish fed test diet 3 (50% BSCP) showed a slight decrease in appetite after several weeks of feeding. The average feed conversion rate for the control was 1.678; test diet 1, 1.660; test diet 2, 1.755; and test diet 3, 2.398. Fish fed test diet 3 (50% BSCP) also showed lower length of growth (inches per day) than did fish fed the control and test diets 1 and 2. The external appearance (color, fins, body conformation, scales, eyes, and gills) and the internal appearance (liver, heart, kidney, spleen, and depot fat) of the control and test diets 1 and 2 fish were all good. Test diet 3 fish showed some loss of dorsal fin but otherwise their appearance resembled that of the control and test diets 1 and 2 fish. The rainbow trout are able to digest 53.3% of the BSCP and 76.1% of the protein of BSCP. The authors conclude that BSCP can be used as a dietary component for rainbow trout.

18279. Pedrick, Robert A. (Ocean Sci. Dept., Naval Oceanogr. Office, Washington, D. C. 20373). 1974. NONMETALLIC ELUTRIATION AND SIEVING DEVICE FOR BENTHIC MACROFAUNA. Limnol. Oceanogr., 19(3): 535-538.

This simply built device for shipboard use incorporates a tilt adjustable 57-liter drum and an effluent collector of high density polyethylene. The nonmetallic construction removes possible sources of heavy metals contamination; an enclosed elutriation drum top helps prevent spillage. (Auth.)

18280. Anderson, Roy M. (Dept. of Zool. and Applied Entomol., Imperial College, Prince Consort Road, London, S.W. 7, England). 1974. POPULATION DYNAMICS OF THE CESTODE Caryophyllaeus laticeps (Pallas, 1781) IN THE BREAM (Abramis brama L.). J. Anim. Ecol., 43(2): 305-321.

The population dynamics of Caryophyllaeus laticeps in the definitive fish host Abramis brama is examined in relation to data obtained by the sampling of natural populations of the host and its parasites. The statistical distribution of parasite counts per host is found to be overdispersed, the negative binomial providing a good empirical model for their description. This distribution also proved to be a good model for the description of the spatial distribution of infected and uninfected intermediate hosts. Possible generating processes are considered for the negative binomial distribution in relation to the biology of Caryophyllaeus laticeps and its final host. The processes are based on random and contagious input of parasites into the fish host. The seasonal cycling of the adult parasite population is considered in the light of the feeding behaviour of the age-group of hosts and a temperature-dependent immune response by the fish host is suggested to explain the seasonal variation in the death rate of the adult parasite. A deterministic immigration-death model is proposed containing non-homogeneous immigration- and death-rates to describe the adult parasite population size in a single host. Conceptual approaches to the mathematical modelling of the population dynamics of the life cycle of C. laticeps are discussed. (Auth.'s summ.)

18281. Goodland, J. C., T. W. Gjernes, and E. L. Brannon (International Pacific Salmon Fish. Comm., New Westminster, British Columbia, Canada). 1974. FACTORS AFFECTING SOCKEYE SALMON (Oncorhynchus nerka) GROWTH IN FOUR LAKES OF THE FRASER RIVER SYSTEM. J. Fish. Res. Board Can., 31(5): 871-892.

Analysis of data from four sockeye rearing lakes of the Fraser River system for periods of up to 20 yr provided information on the relation of estimated fish density (female spawners/ha), temperature, and zooplankton standing crops to growth. The lakes differed widely in all attributes. Growth was inversely related to estimated population density in three of the lakes, but wide variations in growth at low density occurred in the fourth, a cold lake at high elevation with short growing season. In this lake, and to a lesser extent in another lake with short growing season, temperature during fry emergence and early lake residence accounted for much of the recorded fluctuation in growth. Reduced zooplankton abundance was associated with high sockeye density in two of the lakes with intermediate standing crops and greatest sockeye densities, but was not recorded in a lake of low standing crop and intermediate sockeye density. Sockeye feeding was found to be highly selective in one lake, and a limited proportion of the zooplankton standing crop was utilized. It is suggested that reduction in standing crop by grazing of juvenile sockeye, and associated decrease in growth, is greatest as the large zooplankters are progressively reduced in abundance. Further reduction in standing crop and in sockeye growth was suggested to proceed at a slower rate. Competition at high population density was concluded to be the factor most responsible for reducing sockeye growth. (Authors)

18282. Pauley, Gilbert B. (U.S. Dept. of the Interior, Fish & Wildl. Service, Eastern Fish Disease Lab., Kearneysville, West Virginia 25430). 1974. PHYSICO-CHEMICAL PROPERTIES OF THE NATURAL AGGLUTININS OF SOME MOLLUSKS AND CRUSTACEANS. Reprint: Annals of the N. Y. Acad. of Sciences, 234, pp. 145-160.

Naturally occurring substances in the hemolymph of the California sea hare, Aplysia californica, the crayfish Procambarus clarkii, and the blue crab, Callinectes sapidus, are capable of agglutinating a variety of bacteria and vertebrate RBC. These agglutinins may play an important role in the defense of the animals against potential pathogens, by acting as opsonins. They are high-molecular-weight substances that appear to be proteins or to contain a major protein component. For some unknown reason, however, they are completely resistant to a variety of proteolytic enzymes. They are apparently nonspecific; this was indicated by cross-adsorption tests and injections of heterologous RBC. (Auth.'s summ.)

18283. Ivanova, G. M., A. I. Gulyaev, A. V. Sinev, and A. M. Khudov (Alma-Ata Zooveterinary Inst., USSR). 1974. SENSITIVITY OF THE AGENT OF RED ROT OF CARP TO ANILINE DYES, FLUOROCHROMES AND ANTIBIOTICS. (Chuvstvitel'nost' Vozbuditel'ya krasnukhi karpov k anilinovym kraskam, Flyuorokhromam i antibiotikam). Rybnoe Khozyaistvo No. 3, pp. 17-19. Translated by Robert M. Howland.

On the basis of experiments the following conclusions have been drawn: Effective dyes for the control of red rot are: acridine, trypaflavine and brilliant green. Infection of carp with a culture of A. punctata causes illness with typical symptoms of red rot: hyperemia, dropsy, bristling of the scales, ulcers. Cultures killed with chloroform are not toxic. Levomycetin acts fatally on cultures of A. punctata and its use is effective for the treatment of red rot of fish. Furazolidone acts lethally on cultures of A. punctata and protects fish from illness with red rot.

18284. Stadelmann, P., J. E. Moore, and E. Pickett (Dept. of the Environ., Fish. and Mar. Serv., Canada Centre for Inland Waters, Burlington, Ontario, Canada L7R 4A6). 1974. PRIMARY PRODUCTION IN RELATION TO TEMPERATURE STRUCTURE, BIOMASS CONCENTRATION, AND LIGHT CONDITIONS AT AN INSHORE AND OFFSHORE STATION IN LAKE ONTARIO. J. Fish. Res. Board Can., 31(7): 1215-1232.

Annual primary production rates of 270 and 170 g C m⁻² yr⁻¹, respectively, were estimated for an inshore and offshore station in Lake Ontario using the in situ ¹⁴C technique. A lag in increase of both biomass and photosynthesis rate at the offshore station in early summer was attributed to deep vertical mixing. Production/biomass quotients were computed using different biomass parameters such as particulate organic carbon, nitrogen, and chlorophyll *a*. Carbon turnover rates of the seston on an areal basis (m²) were found to vary between 0.04-0.18 day⁻¹ and 0.01-0.21 day⁻¹ at the inshore and offshore station, respectively. Daily photosynthesis efficiency (energy fixed by photosynthesis/available energy) ranged from 0.1 to 1.8% at the two stations. Atypical photosynthesis-light intensity curves showed that algal populations behaved differently at different depths during the stratified period. (Authors)

18285. Stober, Quentin J., and Charles H. Hanson (Fish. Res. Inst., Univ. of Wash., Seattle, Washington 98195). 1974. TOXICITY OF CHLORINE AND HEAT TO PINK (Oncorhynchus gorbuscha) AND CHINOOK SALMON (O. tshawytscha). Trans. Amer. Fish. Soc., 103(3): 569-576.

The toxicity of chlorine to juvenile chinook salmon (Oncorhynchus tshawytscha) was tested at five residual concentrations ranging from 0.05 to 1.0 mg/liter and at four temperatures (Δt 0, 2.6, 4.9, and 10 C) in a matrix design. Juvenile pink salmon (O. gorbuscha) were tested at three temperatures (Δt 0, 5.0, and 9.9 C). Each matrix was stressed at four exposure periods (7.5, 15, 30 and 60 min). An array of LC50 and LT50 values are presented for each of the conditions tested. A decrease in the tolerance of both species to residual chlorine was demonstrated with increasing temperature and exposure time. The 60-min exposure period and the 9.9 and 10 C Δt were the most acutely toxic to each species. The equilibrium loss response for chinook salmon exposed to heat and chlorine preceded the LT50 by at least 55%. The LC50 was 0.045 mg/liter for both species after exposure to fluctuating chlorine concentrations during 2-hr periods. The LT50 occurred in about 100 min at approximately 0.5 mg/liter residual chlorine. Factors contributing to the dynamics of chlorine decay in sea water are discussed. The effect of light reduced the required time to decay (1.0-0.01 mg/liter) by a factor of about 7. The need for fish behavioral studies are suggested as a logical extension of this investigation. (Authors)

18286. Robison, Henry W. (Dept. of Biol. Science, Southern State College, Magnolia, Arkansas 71753). 1974. NEW DISTRIBUTIONAL RECORDS OF SOME ARKANSAS FISHES WITH ADDITION OF THREE SPECIES TO THE STATE ICHTHYOFAUNA. The Southwestern Naturalist, 19(2): 220-223.

18287. Aspinwall, Nevin (Dept. of Biol., St. Louis University, St. Louis, Missouri 63103). 1974. GENETIC ANALYSIS OF NORTH AMERICAN POPULATIONS OF THE PINK SALMON, Oncorhynchus gorbuscha, POSSIBLE EVIDENCE FOR THE NEUTRAL MUTATION - RANDOM DRIFT HYPOTHESIS. *Evolution*, 28(2): 295-305.

The pattern of protein polymorphism variation was examined within 32 North American populations of the pink salmon, Oncorhynchus gorbuscha. In many streams of Alaska, the pink salmon exists as two genetically isolated populations (called odd-year and even-year) because of a rigid two-year life cycle. The phenotypic (or allelic) frequencies of MDH-A, MDH-B, and alpha-GPDH generally showed considerable uniformity within either distantly spaced odd-year or even-year Alaskan populations. However, differences in the phenotypic (or allelic) frequencies occurred between odd- and even-year populations occupying the same streams. This pattern of protein polymorphism variation was discussed in relation to a balancing selection versus the neutral mutation - random drift hypotheses for the maintenance of genetic variability. The data lend support to the latter hypothesis. (Auth.'s summ.)

18288. Claridge, P. N., and I. C. Potter (School of Biol. Sci., Univ. of Bath, United Kingdom). 1974. HEART RATIOS AT DIFFERENT STAGES IN THE LIFE CYCLE OF LAMPREYS. *Acta Zoologica*, 55(2): 61-69.

Heart ratios (heart weight/body weight x 100) have been obtained for freshly killed and preserved (10% formalin) specimens of the lampreys Petromyzon marinus, Lampetra fluviatilis and L. planeri. Values for comparable stages were significantly higher in the preserved material, probably as a result of retention and fixation of blood in the heart chambers. The regression slope for the logarithmic relationship between heart and body weights was close to one in all stages of the three species investigated. A marked increase was observed in the heart ratio during metamorphosis, apparently attributable to an increase in the number and density of myocardial fibres. Heart ratios in the lamprey were generally higher than for most other fishes, with values of 0.1 and 0.3 being obtained for example in the case of freshly killed ammocoete and sexually mature adult stages of L. fluviatilis. (Authors)

18289. Westin, Deborah T. (Mar. Exp. Sta., Univ. of Rhode Island, Kingston, Rhode Island 02881). 1974. NITRATE AND NITRITE TOXICITY TO SALMONOID FISHES. *Prog. Fish-Cult.*, 36(2): 86-89.

The toxicity of nitrate to chinook salmon fingerlings reared in a recirculating system and rainbow trout reared in a conventional hatchery was shown to increase with increasing salinity up to 15 ‰. Mortality was found to increase with an increase in exposure time to nitrate and nitrite concentrations. Nitrite was found to be 2,000 times more toxic than nitrate to the chinook fingerlings tested. Median lethal concentration (TL_m) values were obtained for chinook salmon and rainbow trout fingerlings to nitrate and nitrite concentrations for 96-hour and 7- and 10-day exposure periods in freshwater and 15 ‰. Recommendations were made for not exceeding 25 to 35 ppm NO₃ and 0.012 ppm NO₂ in rearing facilities for the fish species studied. (Auth.)

18290. Ransom, John D., and Carl W. Prophet (Dept. of Biol., Kansas State Teachers College, Emporia, Kansas 66801). 1974. SPECIES DIVERSITY AND RELATIVE ABUNDANCE OF BENTHIC MACROINVERTEBRATES OF CEDAR CREEK BASIN, KANSAS. *Amer. Midl. Nat.*, 92(1): 217-222.

A spring and summer environmental inventory was made on the Cedar Creek Basin and an 18-km stretch of the Cottonwood River downstream from its confluence with Cedar Creek. Environmental qualities of the major streams in the basin were determined by species diversity indices and relative abundance of benthic fauna. A total of 105 taxa was collected. Diversity index (d) values for Cedar Creek and its five major tributaries were all above 3, indicating that these streams had excellent water quality. There was a significant difference ($P = .05$) between the Cedar Creek Basin streams and the Cottonwood River, where the d values were all less than 3. Only 56 taxa were collected from the Cottonwood

River stations. With few exceptions, the benthic fauna at all stations was dominated by Trichoptera, Ephemeroptera, Elmidae, Chironomidae, Sphaeriidae and Dugesia. Caddis flies (Trichoptera) and fingernail clams (Sphaeriidae) were the most important members of the benthic fauna, constituting 50% or more of the total ash-free biomass at most stations. (Authors)

18291. Mugiya, Yasuo (Fac. of Fish., Hokkaido Univ., Hakodate, Japan). 1974. CALCIUM-45 BEHAVIOR AT THE LEVEL OF THE OTOLITHIC ORGANS OF RAINBOW TROUT. Bull. Jap. Soc. Sci. Fish., 40(5): 457-463. In English.

Calcium-45 incorporation and its turnover were examined at the level of the otolithic organs of some rainbow trout. The intraperitoneally-injected isotope showed maximum incorporation into both the serum and otolith fluid within 3 hours after injection. Thereafter the radioactivity in the serum decreased rapidly and that in the otolith fluid gradually. On the contrary, the isotope deposited on the otolith (sagitta) increased with the lapse of time up to 72 hours, which was the final examination time. In this case a heavy accumulation was found to occur not on its lateral surface but on its medial surface where the otolith stands close to the macular cells of the sacculus. Autoradiographic visualization also confirmed such a distribution pattern of the isotope on the otolith. In addition to these facts, judging from the heavy appearance of the isotope in an autoradiogram of the medial macula, the calcium which takes part in the otolith formation seems to be supplied, at least in part, through this region. Some squamous cells of the saccular wall were also positive to radiocalcium. (Auth.)

18292. Hall, Ken J., and Kim D. Hyatt (Westwater Res. Centre, Univ. of Brit. Columbia, Vancouver, British Columbia, Canada). 1974. MARION LAKE (IBP) - FROM BACTERIA TO FISH. J. Fish. Res. Board Can., 31(5): 893-911.

The microbial-detritus food chain in the sediment of Marion Lake, British Columbia, is an important pathway for the cycling of organic matter derived from both allochthonous (leaf litter) and autochthonous (phytoplankton, aquatic macrophytes, and benthic algae) sources. The activity of the sediment microbial community (approximately $10^9 - 10^{10}$ cells/g dry wt) as estimated by oxygen consumption and solute uptake is greatest during the summer months, when water temperatures are higher than 10°C. Solute uptake is also influenced by sediment depth, nutrient enrichment, sediment particle size, and oxygen concentration. Organic matter from natural sources such as algal excretion, interstitial water, and leaf detritus is complex and is not assimilated as rapidly as the simpler organic compounds. Rainbow trout (*Salmo gairdneri*) and kokanee (*Oncorhynchus nerka*) in Marion Lake are characterized by small average size and slow growth rates. Fish production, although highly variable, is at the low end of the range compared to other salmonid producing systems. These characteristics are related to the inefficiency of trout and kokanee in cropping the benthic food supply. Experiments with individual predators and their prey have identified the nature of many of the interactions controlling the availability of benthic prey to the predators. Construction of simulation models shows promise as a means to quantify the importance of such interactions. (Authors)

18293. Hambrick, Patrick S., William T. Bryson, and Charles H. Hocutt (Dept. of Biol., Va. Polytech. Inst. and State Univ., Blacksburg, Virginia 24061). 1974. NEW ANOMALIES IN THREE CYPRINID GENERA FROM SOUTHWEST VIRGINIA. Trans. Amer. Fish. Soc., 103(3): 642.

Abnormal specimens of *Nocomis leptocephalus* with four barbels on the left side of the mouth, *Campostoma anomalum* with a vertebral deformity, and *Notropis cerasinus* with a pug head were collected during recent sampling of the ichthyofauna of the New and Roanoke River drainages in southwestern Virginia. A review of the literature revealed that no anomalies have previously been reported for these species. (Authors)

18294. Hanson, James N. (U.S. Fish & Wildl. Serv., Alchesay-Williams Creek Natl Fish Hatchery, Whiteriver, Arizona 85941). 1974. PORTABLE WEIR FOR MEASURING FISH HOLDING TANK WATER FLOW. Prog. Fish-Cult., 36(2): 85.

18295. Erney, D. Ronald (Food and Drug Admn, 1560 E. Jefferson Ave., Detroit, Michigan 48207). 1974. RAPID SCREENING METHOD FOR ANALYSIS OF CHLORINATED PESTICIDE AND POLYCHLORINATED BIPHENYL RESIDUES IN FISH. J. Assoc. Off. Anal. Chem., 57(3): 576-579; NOAA Marine Fisheries Abstracts, 27(8): p. 25.

A rapid method was developed for screening for chlorinated pesticide and PCB residues in fish, using miniature columns for sample cleanup and separation of PCB, DDT, and analogs prior to gas-liquid chromatography (GLC) determination. The fish sample is ground and dried with anhydrous Na_2SO_4 , packed into a chromatographic column, and extracted with petroleum ether. The extract is subjected to preliminary cleanup on miniature Florisil columns, and PCB's, DDT, and analogs are further separated on miniature columns of silica gel. GLC analyses of a variety of fish samples by the proposed method and by the Pesticide Analytical Manual method (currently used by the Food and Drug Administration) gave comparative results. The proposed method is rapid, economical, and applicable to routine analysis of fish samples.

18296. Svårdson, Gunnar, and Gösta Molin (Inst. of Freshwater Res., Drottningholm, Sweden). 1973. THE IMPACT OF CLIMATE ON SCANDINAVIAN POPULATIONS OF THE SANDER, Stizostedion lucioperca (L.). Inst. of Freshwater Res., Drottningholm, Report No. 53, pp. 112-139.

Six Swedish sander lakes are described and the yield discussed. Two of the lakes are excellent sander habitats, one very unfavorable and the remaining three intermediate ones, including the largest lake of Scandinavia, Lake Vänern. Year classes were studied in two lakes, i.e. Lake Hjälmaren and Lake Mälaren, by fishing fixed localities, with a constant set of gill nets and efforts, over the period 1955-72. The fifteen year classes 1953 through 1967 could be scored in both lakes and were found to fluctuate in a similar way, indicating climatic influence. The score of the year class was significantly correlated to the temperature of some summer months, above all the period June-August. When the regression of year class strength on air temperature was used in two other lakes, the calculated catchable sander populations ran parallel to the known yield. Some evidence was obtained that high water level in spring may add to the strength of a year class. Growth rates are given for the sander of the six lakes. Females grow slightly better than males from their sixth year in Lake Mälaren. The sex ratio is even. Growth is better in warm years, especially for small fish. Population density interferes with growth rate when it is high. There were simultaneous growth rate fluctuations in Lake Hjälmaren and Lake Mälaren, but they were more pronounced in the first lake. Forage fish fauna was reduced in those years. The interaction between sander, pike and perch is most obvious when sander is introduced into new lakes but can be traced at high population levels in other lakes also. The ultimate factor creating dominant year classes in Scandinavian sander is suggested to be first winter mortality. Anything promoting growth, like higher organic production of lakes, higher than average temperature during a certain year, fewer competitive other fish, or the access to spawning grounds permitting unusually early spawning, may all be favourable for the sander. The implications for management are discussed. (Authors' summ.)

18297. McCleave, James D., Kristin A. Stred, and Enoch H. Albert (Migratory Fish Res. Inst., Dept. of Zool., Univ. of Maine, Orono, Maine 04473). 1974. EFFECT OF REINFORCEMENT SCHEDULE AND UNCONDITIONED STIMULUS ON CLASSICAL CARDIAC CONDITIONING IN AMERICAN EELS (Anguilla rostrata). J. Fish. Res. Board Can., 31(7): 1254-1258.

A comparison over 80 training trials of continuous reinforcement with electric shock, reinforcement of every third trial, reinforcement of every fifth trial, and controls without reinforcement, in classically conditioning cardiac deceleration of American eels (Anguilla rostrata) demonstrated the superiority of the continuous reinforcement schedule. However, both intermittent schedules induced some conditioning. Use of a brief "flash of dark" as an alternate unconditioned stimulus to electric shock, was slightly effective in producing conditioned cardiac deceleration. More deceleration occurred in the first interbeat interval following onset of conditioned stimulus (a dim light) than in the second interbeat interval. (Authors)

18298. Hirata, Hachiro (Lab. of Propagation Physiol., Fac. of Fish., Kagoshima Univ., Kagoshima, Japan 890). 1973. STUDIES ON THE DAILY RHYTHM OF FEEDING ACTIVITY IN FISH, ESPECIALLY IN GOLDFISH, Carassius auratus (Linne), Mem. Fac. Fish., Kagoshima Univ., 22(2): 1-18.

Daily rhythm of the feeding activities in fish was investigated in order to know the fundamental aspects of fish behaviour and to apply those to the practical measure of fish cultivation. Six types of automatic feeding recorders were devised. Especially, a waterproof type of contacting tube was designed for both laboratory and field uses. Spawning behaviour in goldfish was also recorded by modifying the field type of the recorder. Seven freshwater and twelve marine fishes were used for examining the daily rhythm of feeding activity, and the three types of the feeding rhythm were classified. (1) The diurnal rhythm of the feeding activity was found in Carassius auratus (Linne), Cyprinus carpio Linne, Epinephelus fasciatus (Forsskal), Girella punctata Gray, Halichoeres poecilopterus (Temminck et Schlegel), Myliobatis macrocephalus (Basilewsky), Oryzias latipes (Temminck et Schlegel), Siganus fasciatus (Houttuyn) and Stephanolepis cirrifer (Temminck et Schlegel). (2) The typical nocturnal rhythm of the feeding activity was found in Parasilurus asotus (Linne) and Triakis scyllia Muller et Henle. (3) Anguilla japonica Temminck et Schlegel, Fugu rubripes (Temminck et Schlegel), F. poecilnotus (Temminck et Schlegel), Goniistius zonatus (Cuvier et Valenciennes), Oncorhynchus keta (Walbaum), Salmo gairdnerii irideus Gibbons and Trachurus japonicus (Temminck et Schlegel) did not show any distinct daily rhythm, at least in the present experiment, though the cultured specimens of O. keta and S. g. irideus were found to be diurnal. Analytical experiments on the rhythmic aspects were carried using the goldfish "Wakin". Effects of the population density on the feeding activity were examined using eight groups of the fish with 430 liters of water in a concrete tank. The growth rate of the fish reared with each group of 3 to 9 individuals in a tank was found to be relatively greater than the other groups examined. So, most of the experiments reported in this paper were carried out using those numbers of the fish per tank. Correlation between the feeding activity and climatic conditions was examined throughout one year and a half. Generally, goldfish showed an active feeding when the atmospheric pressure was upward. On the contrary, the feeding became inactive on a cloudy or rainy day, and almost no feeding was recorded on a stormy day. It was found that the solar radiant heat was one of the most influential factors on their feeding activity during summer. Water temperature appeared to be more effective than the other factors in the seasons of from autumn to early spring. The idea of inflection point, d^2T/dt^2 , was introduced into the analysis of temperature stimulus to the fish in these seasons. The peak of the feeding activity in a day was found to correspond approximately to this inflection point which was found to occur in a few hours before maximum temperature recorded. In early winter, the feeding activity of goldfish was gradually ceased at the temperature around 8.5°C, and in a short time they went to hibernation. The fish began to feed again in early spring at the temperature of about 10.0°C which was slightly higher than the temperature of hibernation initiated. Light experiments were conducted with four light and dark combinations: 12L-12D, 12D-12L, 24L, and 24D. Rhythmic pattern of the feeding activity in 12L-12D showed almost normal daily rhythm, but the fish reared under the condition of 12D-12L showed an atypical rhythm. Persistent rhythm was found in the cases of 24 L and 24D conditions. Four hybrids of goldfish were tested in order to know their respective rhythmic strength. The higher strength was found in cultured types of goldfish, "Demekin" and "Ryukin", and the lower one was observed in two types of "Wakin", that is, the fish with two and three caudal fins. The wildness of the fish behaviour concerning those rhythmic strengths was discussed in this paper. Spawning behaviour of goldfish was also examined with a modified contacting tube at the same time as the feeding records were made. In spring the spawning behaviour was initiated from around 4 o'clock in the morning, and the maximum spawning activity was recorded during the time of 5 to 6 o'clock. Their feeding activity was found to be slightly weakened and recorded at 10 or 11 o'clock on the spawning days, while they started to feed at about 8 o'clock normally. (Auth.)

18299. Kelso, J. R. M., E. E. Pickett, and R. G. Dowd (Dept. of the Environ., Fish. & Mar. Serv., Canada Centre for Inland Waters, Great Lakes Biolimnol. Lab., Burlington, Ontario, Canada L7R 4A6). 1974. A DIGITAL ECHO-COUNTING SYSTEM USED IN DETERMINING ABUNDANCE OF FRESHWATER PELAGIC FISH IN RELATION TO DEPTH. J. Fish. Res. Board Can., 31(6): 1101-1104.

The digital echo-counting system consisted of a 200 kHz echo-sounder, cathode-ray tube, preamplifier rectifier, and digital logic. Incoming signals were gated by delayed pulses of 6.6 msec duration to represent 5 m depth shells from 5 to 25 m depth. Response to density was linear. Acoustic estimates of density ranged from 19.3/10,000 m³ to 524.0/10,000 m³ and trawl estimates of density ranged from 17.4/10,000 m³ to 420.0/10,000 m³. A high degree of correlation (0.94) existed between densities estimated acoustically and by midwater trawl. Species differences, smelt in Lake Erie, and alewife in Lake Ontario, did not seem to affect density estimates. (Authors)

18300. Perret, William S., and Charles W. Caillouet, Jr. (Louisiana Wildlife and Fish. Comm., New Orleans, Louisiana 70130). 1974. ABUNDANCE AND SIZE OF FISHES TAKEN BY TRAWLING IN VERMILION BAY, LOUISIANA. Bull. Mar. Sci., 24(1): 52-75.

Fishes were collected with a 4.9-m flat otter trawl at three sampling stations (Vermilion River Cutoff, Redfish Point, and Southwest Point) in Vermilion Bay, Louisiana, from June 1964 through September 1965. In 273 10-minute tows, 10,710 fish representing 43 species and 24 families were collected. The greatest number of species and the greatest number of individuals were taken at Southwest Point, the sampling station nearest the Gulf of Mexico. Vermilion River Cutoff, the northernmost location, most distant from the Gulf, exhibited the fewest species and individuals. Fishes in the family Sciaenidae occurred most frequently and in greatest number in the trawl catches. The Atlantic croaker (Micropogon undulatus) was the most abundant species taken. For each sampling station, the species collected, their frequencies of occurrence, and their numerical abundance were reported. Relative abundance and frequency distribution of size of the most frequently occurring fishes were determined. (Authors)

18301. Reynolds, Norman B., and Linda M. Mercer (State Univ. of N. Y., College at Cortland, Cortland, New York). 1974. A PRELIMINARY PHYTOPLANKTON SURVEY OF TWELVE ADIRONDACK LAKES. N. Y. Fish Game J., 21(1): 58-66.

This investigation was conducted to evaluate the relationships between composition and abundance of phytoplankton in 12 lakes in the Adirondack region of New York. Possible differences in eutrophication are also considered. Five divisions and 60 taxa were catalogued. All the lakes were found to be oligotrophic and dystrophic although there was some indication of pollution. Possible effects of Hurricane Agnes in 1972 are discussed. (Authors)

18302. Titlow, Franklin B., and Robert T. Lackey (Dept. of Fish. and Wildl. Sciences, Virginia Polytechnic Inst. and State Univ., Blacksburg, Virginia 24061). 1974. DAM: A COMPUTER-IMPLEMENTED WATER RESOURCE TEACHING GAME. Trans. Amer. Fish. Soc., 103(3): 601-609.

Development and use of DAM, a computer-implemented learning exercise designed to illustrate management of a large multiple-use reservoir system, is described. Five management roles are available to students using DAM: (1) a regional planning commissioner; (2) a fisheries manager; (3) a power company executive; (4) a recreation specialist; and (5) a city mayor. We found that allowing students to switch roles emphasized inherent management conflicts and increased total system appreciation. There is no "best" management scheme for DAM. In practice, students manage until they can agree on and defend a particular strategy. The specific goal of DAM is to provide students with an understanding of the principles and problems of managing a multiple-use resource. Response from students indicates this goal was achieved. DAM is currently played by students' keypunching decisions on computer cards and submitting these to the computer center. An improvement would be to place DAM on a permanent file for access by remote typewriter terminal. (Authors)

18303. Kanep, S. V. (GosNIORKh, USSR). 1974. COMPARATIVE PRODUCTIVITY OF CERTAIN WHITEFISHES (Sravnitel'naya produktivnost' nekotorykh sigovykh ryb). Rybnoe Khozyaistvo, No. 4, pp. 26-27. In Russian, translated by Robert M. Howland.

The general dependence of the age of maximal productivity (y) on the amount of heat in the waters of residence (x) for certain species of whitefishes is expressed by the following equations of regression:

Broad whitefish $Y = -0.0048x + 13.96$; 21 date $\eta_{y/x} = -0.818 \pm 0.072$.

Peled $Y = -0.0023x + 9.80$; 46 date $\eta_{y/x} = -0.495 \pm 0.111$.

Whitefish $Y = -0.0037x + 6.73$; 75 date $\eta_{y/x} = -0.548 \pm 0.081$.

Cisco $Y = -0.0019x + 7.30$; 88 date $\eta_{y/x} = -0.417 \pm 0.088$.

Consequently, half of all the factors affecting the attainment of maximal productivity of the whitefishes depends on the factor of the amount of heat (in the broad whitefish this factor takes on even greater importance). The European cisco probably is the most profitable object of whitefish culture. Independent of the living conditions large and small forms of ciscoes usually possess a high rate of growth; as a rule, they reach sexual maturity at the age of two-, more seldom three years (the age of maximal productivity).

18304. Geen, G. H. (Dept. of Biol. Sciences, Simon Fraser Univ., Burnaby, British Columbia, Canada). 1974. EFFECTS OF HYDROELECTRIC DEVELOPMENT IN WESTERN CANADA ON AQUATIC ECOSYSTEMS. J. Fish. Res. Board Can., 31(5): 913-927.

The effects of some existing and proposed hydroelectric developments on lakes and rivers of Western Canada are considered. There are few pre- and postimpoundment studies from this region on which to base generalizations, although the changes in species composition and water chemistry following impoundment of rivers and lakes reported thus far are comparable to those observed in other areas at similar latitudes. Few data are available which permit prediction of thermal regimes in newly formed reservoirs, particularly in view of the turbid nature of some inflows to reservoirs. Several hydroelectric developments have blocked or impeded migrations of economically important fish and appear likely to produce a number of downstream changes in water temperature or composition, the effects of which are often speculative. More studies of the effects of altered temperature and flow regimes, reduced turbidity, and gas supersaturation are required. (Auth.)

18305. Ghittino, Pietro (Dept. Med. Microbiol., Coll. of Vet. Med. Univ. of Georgia, Athens, Georgia 30602). 1973. ESTUARINE FISH CULTURE IN EUROPE. Riv. It. Piscic. Ittiop., 8(2): 37-41.

18306. Watanabe, Takeshi, Chinkichi Ogino, Yuichi Koshiishi, and Tomiyuki Matsunaga (Lab. of Fish. Biochem., Tokyo Univ. of Fish., Konan 4, Minato-ku, Tokyo, Japan). 1974. REQUIREMENT OF RAINBOW TROUT FOR ESSENTIAL FATTY ACIDS. Bull. Jap. Soc. Sci. Fish., 40(5): 493-499. In English.

Requirement of rainbow trout for essential fatty acids (EFA) was examined by feeding diets containing different levels of methyl linolenate. The shortage of EFA resulted in poor growth and low feed conversion. Methyl linolenate was superior to methyl linoleate in both enhancing growth and improving feed conversion. A diet containing 5% methyl laurate elevated the level of eicosatrienoic acid (20:3 ω 9) in the body lipids, while it was depressed by dietary linoleate and linolenate. Methyl linoleate elevated levels of 20:4 ω 6 and 22:5 ω 6 acids in polar lipids of the liver and methyl linolenate that of 22:6 ω 3 acid. From growth, feed conversion, the ratio of 20:3 ω 9/22:6 ω 3 in the polar lipids of liver and histological observation, the requirement of rainbow trout for methyl linolenate was judged to be between 0.83 and 1.66% in diet. (Authors)

18307. Jhingran, V. G., and V. Gopalakrishnan (Central Inland Fish. Res. Inst., Barrackpore, India). 1974. CATALOGUE OF CULTIVATED AQUATIC ORGANISMS. FAO Fisheries Technical Paper No. 130, 83 p. (Distribution restricted).

18308. von Mecklenburg, Claes (Dept. of Zool., Univ. of Lund, Sweden). 1974. THE DEVELOPMENT OF SACCUS VASCULOSUS IN TWO TELEOSTS. *Acta Zoologica*, 55(2): 137-148.

The development and differentiation of the ventro-caudal part of the diencephalon, the saccus infundibuli, has been examined in salmon, Salmo salar L., and in pike, Esox lucius L. In salmon, the saccus infundibuli becomes the saccus vasculosus; but in pike, this does not occur. The question of saccus vasculosus and part of the neural lobe of the tetrapod pituitary being homologous is dealt with. (Auth.)

18309. Mathur, Dilip, and John S. Ramsey (Dept. of Fish. and Allied Aquacult., Agric. Exp. Sta., Auburn Univ., Auburn, Alabama 36830). 1974. FOOD HABITS OF THE ROUGH SHINER, Notropis baileyi Suttkus and Raney, IN HALAWAKEE CREEK, ALABAMA. *Amer. Midl. Nat.*, 92(1): 84-93.

In Halawakee Creek, the rough shiner, Notropis baileyi, showed two distinct feeding peaks, one during the daylight and the other during the hours of darkness. Immature forms of Diptera, Ephemeroptera, and terrestrial insects were dominant in the diet during the 24-hr period. These organisms were also common in the drift samples taken concurrently with the fish. Daily ration varied from 5.9 to 6.5% of the body weight. Feeding intensity was lowest in winter, highest in spring and summer and moderate in autumn. Fish less than 35 mm fork length fed on dipteran larvae, terrestrial insects and detritus throughout the year. The diet of the larger fish (>35 mm) was dominated by terrestrial insects, ephemeropteran nymphs, trichopteran larvae and detritus. The diet of the larger fish was more diverse than that of the smaller individuals. The opportunistic feeding habits are in part responsible for the success of this introduced species in Halawakee Creek. (Authors)

18310. Spieler, Richard E. (Dept. of Mar. Sciences, Center for Wetland Resources, Louisiana State Univ. and Agric. and Mech. Coll., Baton Rouge, Louisiana 70803). 1974. SHORT-TERM CORTISOL CONCENTRATIONS IN GOLDFISH (Carassius auratus) SUBJECTED TO SERIAL SAMPLING AND RESTRAINT. *J. Fish. Res. Board Can.*, 31(7): 1240-1242.

Serum cortisol from serially sampled goldfish (Carassius auratus) did not demonstrate a stress-evoked increase ($P > .05$) until 10-22 min after initial capture. This response did not differ ($P > 0.5$) among fish sampled at the beginning, middle, and end of a 14-h light period. (Auth.)

18311. Warner, Kendall (Maine Dept. of Inland Fish. and Game, Bangor, Maine 04401). 1974. UTILIZATION OF FISH AS SPRING FOOD BY WHITE PERCH AND YELLOW PERCH IN MAINE LAKES. *Prog. Fish-Cult.*, 36(2): 96-98.

Samples of white perch (341) and yellow perch (290) were collected for stomach analysis from 18 Maine lakes from 1967 to 1970. The purpose of this study was to compare use of fish as forage in early spring (May) and to compare fish utilization in relation to the size of the two predator species. A major difference in forage fish consumption was more extensive utilization of fish by yellow perch (31.3% occurrence) than by white perch (17.8% occurrence). Yellow perch began to eat fish at a much smaller size (140 mm) than white perch (220 mm). Yellow perch ate forage fish at a higher rate than white perch in all size groups in which fish consumption occurred. (Auth.)

18312. Echelle, Anthony A., and Robert Rush Miller (Univ. of Okla. Biol. Sta., and Dept. of Zool., Norman, Oklahoma 73069). 1974. REDISCOVERY AND REDESCRIPTION OF THE LEON SPRINGS PUPFISH, Cyprinodon bovinus, FROM PECOS COUNTY, TEXAS. *Southwest. Nat.*, 19(2): 179-190.

The Leon Springs pupfish, Cyprinodon bovinus Baird and Girard, has been rediscovered after being considered extinct for more than 30 years. The present population is restricted to an 8-10 km segment of Leon Creek and contiguous springs about 15 km downstream from, and in the same drainage as, the type locality for the species. The species is redescribed and its populational status and relationships to other species of Cyprinodon are discussed. (Authors)

18313. Kelso, John R. M., and Richard Frank (Ontario Min. of Nat. Res., Nanticoke Project, Port Dover, Ontario, Canada). 1974. ORGANOCHLORINE RESIDUES, MERCURY, COPPER AND CADMIUM IN YELLOW PERCH, WHITE BASS AND SMALLMOUTH BASS, LONG POINT BAY, LAKE ERIE. Trans. Amer. Fish. Soc., 103(3): 577-581.

Three collections of yellow perch, white bass and smallmouth bass were made in May, July and late October for analyses of DDT, PCB, mercury, copper and cadmium. Fat content varied seasonally among collections, lowest in spring and highest in fall. Total DDT residues were low for all species. Means ranged from 0.09 to 0.27 $\mu\text{g/g}$ and exhibited no seasonal changes. No difference among species existed for DDT in spite of differing fat content, but concentrations within a species increased with increasing fat and subsequently age. PCB's were up to 6.5 times greater than DDT levels. PCB residues, lowest in yellow perch and highest in white bass, did not vary with season but increased with increasing fat. Dieldrin was low and no trends relating to season or fat were apparent. Only two specimens contained mercury residues above 0.5 $\mu\text{g/g}$. Mercury was apparently related to size and subsequently age. Copper was slightly higher in yellow perch, means ranged from 1.29 to 1.56 $\mu\text{g/g}$, but copper and cadmium were low in all species. (Authors)

18314. Lanner, Magnus, and Birger Pejler (Inst. of Zool., Univ. of Uppsala, Sweden). 1973. THE EFFECT OF COOLING WATER DISCHARGES ON ZOO-PLANKTON IN A BAY OF LAKE MÅLAREN. Inst. of Freshwater Research, Drottningholm, Report No. 53, pp. 31-33.

A relatively high frequency of species, as well as individuals, was noted in the middle of winter (March 1972) in the inner part of Västerås Bay, which is affected by cooling water discharges from two power stations as well as by municipal sewage from the city of Västerås. In a strip of open water in the ice just outside one of the power stations, where the temperature at some places exceeded $+9^{\circ}\text{C}$, a pronouncedly warmwater stenothermal rotifer occurred, Polyarthra remata, previously never found in the winter. (Authors' summ.)

18315. Schindler, D. W., and E. J. Fee (Dept. of the Environ., Fish. & Mar. Serv., Freshwater Inst., Winnipeg, Manitoba, Canada R3T 2N6). 1974. EXPERIMENTAL LAKES AREA: WHOLE-LAKE EXPERIMENTS IN EUTROPHICATION. J. Fish. Res. Board Can., 31(5): 937-953.

The following whole-lake experiments are described; Lake 227, fertilized for 5 yr with phosphate and nitrate, has shown an enormous increase in phytoplankton, in spite of low carbon concentrations. The carbon necessary for production of algal blooms was found to invade from the atmosphere. Lake 304, eutrophied by fertilization with phosphorus, nitrogen, and carbon in 1971 and 1972, recovered rapidly when phosphorus fertilization was terminated. Lake 226 was split in half with a curtain. One half was fertilized with carbon and nitrogen and the other was fertilized with phosphorus, carbon, and nitrogen. The half of the lake receiving phosphorus developed an algal bloom and the other half did not. Lake 302, which had carbon, nitrogen, and phosphorus added to the hypolimnion, did not develop algal blooms in summer. Small phytoplankton blooms were found under ice in early December, but all nutrients were efficiently sedimented and unavailable the following year. The above studies illustrate clearly that phosphorus control is an efficient primary step in preventing or checking eutrophication problems. A review of other published and ongoing studies in the Experimental Lakes Area is given, illustrating the role which large-scale experiments can play in interpreting environmental problems. (Authors)

18316. Tubiash, Haskell S. (NMFS, Mid. Atlantic Coastal Fish. Center, Oxford, Maryland 21654). 1974. A TEMPERING RESERVOIR AND MANIFOLD FOR FLOWING-WATER AQUARIUMS. Prog. Fish-Cult., 36(2): 114.

A simple, inexpensive tempering reservoir and manifold for flowing water systems was constructed using a plexiglass tank, thermostatically-controlled heated circulator, and appropriately arranged stopcocks. The unit can elevate the temperature of 1 liter per minute flow-through water by approximately 15°C . (Auth.)

18317. Natochin, Yu. V., and E. A. Lavrova (Sechenov Inst. of Evol. Physiol. and Biochem., Leningrad, USSR). 1974. THE INFLUENCE OF WATER SALINITY AND STAGE IN LIFE HISTORY ON ION CONCENTRATION OF FISH BLOOD SERUM. J. Fish Biol., 6(5): 545-555.

The Na, K, Ca, Mg concentration of blood serum have been studied in nearly 60 fish species from various waterbodies (the Neva, Lake Dal'nee, the Volga, Lake Baikal, the White Sea, the Black Sea, the Barents Sea etc.). In fishes (Cyprinidae, Percidae, Siluridae, etc.) from fresh water (Lake Dal'nee, the Baikal, the Neva) with low 0.18-0.24 mEq/l Na concentration Na content in blood serum was lower than in closely related species from fresh water (the Volga, Lyutoga River) with larger Na concentration - nearly 0.5-1 mEq/l. Blood serum of marine teleosts Na concentration (156-210 mEq/l) was higher than in migrating and freshwater species (90-174 mEq/l) and it did not depend on seawater salinity: Barents Sea - 465, White Sea - 255, Black Sea - 227 mEq/l. Rather a considerable specific variation of ion concentration was found in blood serum of fishes from different families living in the same water body (Lake Baikal: Cyprinidae 90-95 mEq/l, Percidae 114 mEq/l, Salmonidae 126-129 mEq/l etc.; the Volga: Siluridae 139 mEq/l, Percidae 142-150 mEq/l, Clupeidae 174 mEq/l). No relation has been detected between K, Ca and Mg concentrations in blood serum of fishes and the concentrations of these ions in the environment. Na concentration in the blood serum of sockeye salmon juveniles (101 mEq/l) migrating seaward was less than in adult fishes (132 mEq/l) returning to the lake to spawn. Na concentration in the blood of non-migrating salmonids (*Oncorhynchus nerka* adult residual 104 mEq/l, *Salvelinus alpinus* juvenile 140 mEq/l, adult residual 141 mEq/l) changed insignificantly during life history. Notable hypopotassemia was observed in spawning time in Salmonidae. The comparison of blood serum ion concentration in males and females of fishes from different taxonomic groups (Acipenseridae, Salmonidae, Cyprinidae) showed no significant variation.

18318. Pearse, L., R. S. V. Pullin, D. A. Conroy, and D. McGregor (Min. of Agric., Fish. and Food, Fish. Lab., Port Erin, Isle of Man, United Kingdom). 1974. OBSERVATIONS ON THE USE OF FURANACE FOR CONTROL OF VIBRIO DISEASE IN MARINE FLATFISH. Aquaculture, 3(3): 295-302; NOAA Marine Fisheries Abstracts, 27(10), p. 1

Furanace is the trade name of a new vinylogous nitrofurane derivative which was developed as a chemotherapeutic agent for use with fish. Tests were performed in vitro to determine the minimum inhibition concentrations (MIC) against strains of pathogenic *Vibrio anguillarum* and a few other strains of *Vibrio* isolated from marine fish and salmonids. All the strains were sensitive to Furanace; the highest MIC was 3.1 µg/ml for one vibrio strain. All the other strains were sensitive to a MIC of less than 1.6 µg/ml. Three species of flatfish were immersed in water containing Furanace to determine their uptake rate of the agent. Plaice, Dover sole, and brill (*Scophthalmus rhombus*) rapidly took up Furanace from water containing low concentrations (5-10 µg/ml) at 9.5°-11.5° C. The uptake varied between species. In most cases blood levels above 1 µg/ml were achieved after 1 hour; two hours later, 70% of the Furanace had been eliminated from the blood. The rate of uptake and excretion of the agent may be related to the body size, gill area, oxygen concentration, metabolism, and respiratory rate. Uptake and elimination of Furanace was more rapid in plaice than in the other fish. In studies of the effects of Furanace on Dover sole and plaice inoculated with *Vibrio* species, preliminary results indicate that the agent can eliminate the bacteria involved in systemic infections. The fish are immersed in water containing Furanace; recovery is complete provided treatment is started before the fish become grossly anemic. The authors suggest that Furanace has a potential for use as a therapeutic agent against vibrio infections in fish. Treatment is more effective by immersing the fish in water containing the Furanace for short periods of time than oral administration. The agent is suitable for use in food fishes because it is eliminated rapidly and delays in marketing the fish after treatment would be minimal.

18319. Barnabe, Gilbert (Sta. de Biologie Marine et Lagunaire, Aquaculture, 1, Quai de Bosc - 34200 Sete, France). 1973. MASS REARING OF THE BASS Dicentrarchus labrax L. Reprint from: The Early Life History of Fish - The Proceedings of an Internatl Symposium held at the Dunstaffnage Mar. Res. Lab. of the Scottish Mar. Biol. Assoc. at Oban, Scotland, from May 17-23, 1973, pp. 749-753.

Maturing females of Dicentrarchus labrax, after a hormone injection, are placed in a tank of 2.5 m³ with naturally running males. They then spawn viable eggs which the males fertilize normally. The pelagic eggs above a salinity of 34.5 ‰ and a temperature of 15°C are collected and incubated in illuminated still water in which planktonic algae ('green water') has previously been cultured. Hatching occurs after 70 h. Two days after hatching, the rotifer Brachionus plicatilis, separately cultured, is introduced into the medium. The best results are obtained with a rearing density of about 5 rotifers/ml. The rotifers can be replaced by the ciliate Fabrea salina. Five days later, the density can be reduced to 1/ml. From the 12th day, nauplii of Artemia salina are provided alternately with the rotifers. Artemia given for several days alone are inadequate as food. From the 15th to 35th day Artemia are given alternately with plankton hauls (mainly the copepod Eurytemora velox). From the 30th day to the end of the experiment the food consists of minced fish and crab. In 5 circular tanks, each of 13 m³ and consisting of a plastic liner inside a plywood cylinder, 45,000 alevins were produced. (Auth.'s summ.)

18320. Thomas, Allan E. (U. S. Fish and Wildlife Serv., Fish Genetics Lab., Beulah, Wyoming 82712). 1974. AN ANNOTATED BIBLIOGRAPHY ON EXERCISE, STAMINA, AND SWIMMING ABILITY IN FISHES. A working paper of the workshop on salmon and trout stamina, December 2, 1970 at Portland, Oregon, 373 p.

This paper is a compilation of 350 reports dealing with exercise, stamina, and swimming ability in fishes. Of this number 298 reports were compiled through July 1971. Abstracts and subject indexes are included for 274 reports. The remaining 24 reports were not examined and are listed and subject indexed by title only. An addendum to the text lists a further 52 references found since July 1971. Abstracts are included for 35 of the addendum references, but none are included in the subject index. (Auth.)

18321. Stockner, J. G., and T. G. Northcote (Dept. of the Environ., Fish and Mar. Serv., Pacific Environ. Inst., West Vancouver, British Columbia, Canada). 1974. RECENT LIMNOLOGICAL STUDIES OF OKANAGAN BASIN LAKES AND THEIR CONTRIBUTION TO COMPREHENSIVE WATER RESOURCE PLANNING. J. Fish. Res. Board Can., 31(5): 955-976.

Results of limnological investigations of Okanagan mainstem and headwater lakes are reviewed in relation to their input to studies of comprehensive water resource management in the Okanagan Valley, British Columbia. The current trophic state of the lakes is discussed on the basis of our understanding of their current condition and areal annual loads of total phosphorus. The practical usefulness of limnological data in this multi-disciplinary study is reviewed, and specific investigations are discussed in relation to their essential and nonessential components, and how these have or have not contributed to the development of management strategies. The role of limnologists in this type of applied study is discussed and their cooperation in similar types of studies is encouraged. (Authors)

18322. Schachte, John H., Jr. (Dept. of Fish. and Allied Aquacult., Ala. Agric. Exp. Sta., Auburn, Univ., Auburn, Alabama 36830). 1974. A SHORT TERM TREATMENT OF MALACHITE GREEN AND FORMALIN FOR THE CONTROL OF Ichthyophthirius multifiliis ON CHANNEL CATFISH IN HOLDING TANKS. Prog. Fish-Cult., 36(2): 103-104.

An infection of Ichthyophthirius multifiliis on channel catfish in holding tanks was treated for 3, 4, and 5 hours on 3 consecutive days with a combination treatment of 0.1 ppm malachite green and 15 ppm formalin. On the day following the third treatment no signs of I. multifiliis on the fish could be detected. (Auth.)

18323. Schimmel, Steven C., David J. Hansen, and Jerrold Forester (U.S. Environ. Protection Agency, Gulf Breeze Environ. Res. Lab., Sabine Island, Gulf Breeze, Florida 32561). 1974. EFFECTS OF AROCLOR 1254 ON LABORATORY-REARED EMBRYOS AND FRY OF SHEEPSHEAD MINNOWS (Cyprinodon variegatus). Trans. Amer. Fish. Soc., 103(3): 582-586.

Eggs of the sheepshead minnow (Cyprinodon variegatus) were artificially fertilized and maintained at temperatures from 15 to 35°C and in salinities from 0 to 35‰ to determine efficient culture conditions. Fertilization was not affected by temperature or salinity ranges chosen, but hatching success was greatest (X^2 ; $a = 0.01$) at a temperature range of 24 to 35°C and a salinity range of 15 to 30‰. Artificially fertilized sheepshead minnow eggs were exposed to logarithmic concentrations of Aroclor 1254 (10.0 to 0.1 µg/liter) in seawater averaging 30°C and 24‰ in a flow-through bioassay. Fertilization was not affected but significantly fewer embryos developed in the 10.0 µg/liter concentration, and fewer fry survived in concentrations greater than 0.1 µg/liter. Fry were more susceptible to Aroclor 1254 than were embryos, juveniles, or adults. (Authors)

18324. Beadles, John K. (Div. of Biol. Sci., Arkansas State Univ., State Univ., Arkansas 72467). 1974. THE SPOTFIN SHINER IN NORTHEASTERN ARKANSAS. The Southwestern Naturalist, 19(2): 219-220.

18325. Dörfel, Hans-Joachim (6453 Seligenstadt, Merianstr. 6, West Germany). 1974. STUDIES ON THE PROBLEM OF THE POPULATIONS OF ARCTIC CHAR (Salvelinus alpinus L.) IN ÜBERLINGER SEE (BODENSEE) [Untersuchungen zur Problematik der Saiblingspopulationen (Salvelinus alpinus L.) im Überlinger See (Bodensee)]. Archiv für Hydrobiologie, 47(1) (Suppl. Vol.): 80-105. In German.

It is long known that in many lakes containing Salvelinus alpinus the populations seem to be split up into two or more subpopulations. The taxonomic position of these subpopulations is not yet clarified. In Überlinger See two discrete populations have been found and caught with sinking gillnets. The studies include form, coloration, vomer, gillraker, food habits, spawning habits, age, and growth. A description of the two populations is given. The difference in the number of gill-rakers is highly significant. Probably the two populations live at different depths in the lake. They spawn at different times and probably also at different places. The possibilities of simplifying the systematics of these fish are discussed. (Auth.)

18326. Turner, Bruce J. (Dept. of Biol., Univ. of California, Los Angeles, California 90024). 1974. GENETIC DIVERGENCE OF DEATH VALLEY PUFFISH SPECIES: BIOCHEMICAL VERSUS MORPHOLOGICAL EVIDENCE. Evolution, 28(2): 281-294.

18327. Allen, Robin L., and Pereti Basasibwaki (Inst. of Animal Resource Ecology, Univ. of Br. Columbia, Vancouver 8, British Columbia, Canada). 1974. PROPERTIES OF AGE STRUCTURE MODELS FOR FISH POPULATIONS. J. Fish. Res. Board Can., 31(6): 1119-1125.

The behavior of a class of dynamic population models that can be described as a life table operating on a population with a stock recruit relation formed by the product of the egg production and a survival function was examined. A combination of analytical and simulation methods were used to find necessary conditions for the stability of equilibrium populations and the properties of fluctuations about the equilibrium. Regular oscillations that occurred in populations with an unstable equilibrium were of most interest and these were considered as possible causes of the regular fluctuations in populations of fish such as sockeye salmon, Oncorhynchus nerka, or blue pike, Stizostedion vitreum glaucum. (Authors)

18328. Nilsson, Nils-Arvid, and Birger Pejler (Inst. of Freshwater Res., Drottningholm, Dept. of Zoology, Univ. of Uppsala, Sweden). 1973. ON THE RELATION BETWEEN FISH FAUNA AND ZOOPLANKTON COMPOSITION IN NORTH SWEDISH LAKES. Inst. of Freshwater Research Drottningholm, Report No. 53, pp. 51-77.

18329. Nieman, Roy L., and Dale C. Wallace (Dept. of Biol., East Mich. Univ., Ypsilanti, Michigan 48197). 1974. THE AGE AND GROWTH OF THE BLACK-STRIPED TOPMINNOW, Fundulus notatus Rafinesque. Amer. Midl. Nat., 92(1): 203-205.

The investigation of the age and growth of the blackstripe topminnow, Fundulus notatus Rafinesque, is based on 125 specimens collected in the Huron River, Washtenaw Co., Michigan. Three age groups were present. There was no difference in the growth of the sexes. The young-of-the-year grow rapidly the first summer, reaching a mean length of 40.7 mm, while those of Age Group I were 53.7 mm. (Authors)

18330. Barclay, Lee A., Jr., and William Mike Howell (Alabama Coop. Fish. Unit., Auburn Univ., Auburn, Alabama 36830). 1973. ICHTHYOFAUNA OF THE LOCUST FORK OF THE BLACK WARRIOR RIVER SYSTEM OF ALABAMA. Reprint from The Journal of the Alabama Acad. of Science, 44(2): 120-146.

The Locust Fork, one of the two main headwater tributaries to the Black Warrior River, drains an area of some 1250 square miles in north central Alabama. One hundred three collections from 80 stations revealed the presence of 74 species representing 16 families of fishes that presently occur in the Locust Fork drainage. Pertinent comments on life history, systematics, and occurrence in the study area are presented. New records of Anguilla rostrata, Notropis ardens, N. chrosomus, N. trichroistius, and N. whipplei are given for the Black Warrior River system. Stream capture and water pollution are discussed as primary factors influencing the distribution of fishes in the Locust Fork drainage system. The Locust Fork fish fauna is compared with that of adjacent drainages. (Authors)

18331. UNESCO (Place de Fontenoy, 75700-Paris, France). 1974. A REVIEW OF METHODS USED FOR QUANTITATIVE PHYTOPLANKTON STUDIES. FINAL REPORT OF SCOR WORKING GROUP 33. Unesco Technical Papers in Marine Science No. 18, 27 p.

18332. Guseva, T. V. (Turkmen Div. of TsNIORKh, USSR). 1974. ON ARTIFICIAL PROPAGATION OF THE MARINE PIKEPERCH (Ob Iskusstvennom Razvedenii morskogo sudaka). Rybnoe Khozyaistvo No. 5, pp. 10-11. In Russian translated by Robert M. Howland.

Young marine pikeperch were reared successfully to a length of 37.7 mm (28.0-48.0), an average mass of 591 mg (225-860), and the coefficient of condition according to Fulton was 1.48 (1.27-1.68).

18333. Dobson, Hugh F. H., Michael Gilbertson, and Peter G. Sly (Dept. of the Environ., Fish. and Mar. Serv., Canada Centre for Inland Waters, Burlington, Ontario, Canada L7R 4A6). 1974. A SUMMARY AND COMPARISON OF NUTRIENTS AND RELATED WATER QUALITY IN LAKES ERIE, ONTARIO, HURON, AND SUPERIOR. J. Fish. Res. Board Can., 31(5): 731-738.

A summary is made, from recent data obtained by the Canada Centre for Inland Waters, of nutrients and water quality of offshore waters of the Great Lakes (excluding Lake Michigan). A simple indexing system, based on a limited number of variables, is used to describe related water quality. (Authors)

18334. Valdez, Richard A. (The Ecology Center, Utah State Univ., Logan, Utah 84322). 1974. TWO PARASITES OF THREESPINE STICKLEBACK FROM AMCHITKA, ALEUTIAN ISLANDS, ALASKA. Trans. Amer. Fish. Soc., 103(3): 632-635.

From 1,760 freshwater threespine stickleback examined, plerocercoids of Schistocephalus solidus and parasitic copepods, Thersitina gasterostei, were found on 22% and 21%, respectively. The former was more common in pond fish (29%) than stream fish (4%), and conversely the latter was more common in stream fish (56%) than pond fish (7%). Fish infested with S. solidus were hindered in speed and agility; those with T. gasterostei had hypertrophied gill filaments. (Auth.)

18335. Hirose, Keiji, and Rikizo Ishida (Tokai Reg. Fish. Res. Lab., Arasaki, Nagai, Yokosuka 238-03, Japan). 1974. EFFECTS OF CORTISOL AND HUMAN CHORIONIC GONADOTROPHIN (HCG) ON OVULATION IN AYU Plecoglossus altivelis (Temminck & Schlegel) WITH SPECIAL RESPECT TO WATER AND ION BALANCE. J. Fish Biol., 6(5): 557-564.

This study was undertaken to discern the effects of cortisol and human chorionic gonadotrophin (HCG) on ovulation in ayu, Plecoglossus altivelis (Temminck & Schlegel), with special reference to water and ion changes. Cortisol as well as HCG was very effective in inducing ovulation of ayu. The best response was obtained with 10 mg of cortisol. In combination of cortisol and HCG, the effective dosage of cortisol was less than when cortisol was used singly. In fish which received cortisol and/or HCG, both the gonadosomatic index (GSI) and the percentage increase in body weight were significantly greater when compared to the control. The increase in body weight appeared to be due to an ingestion of water in fish treated with hormone, as described in our previous report. At ovulation there was a high sodium content in the ovary of fish treated with hormones, whereas a low sodium content was seen in the muscle. It appears that the fish imbibes some water resulting in hydration of the oocytes with concurrent ion movement during maturation and ovulation. These results suggest that gonadotrophin and cortisol may exert their initial effect on the oocytes in a direct or indirect manner, possibly acting to affect the sodium transport system or to alter passive permeability of the egg membrane. (Authors)

18336. Vrijenhoek, Robert C., and R. Jack Schultz (Dept. of Biol., Southern Methodist Univ., Dallas, Texas 75275). 1974. EVOLUTION OF A TRIHYBRID UNISEXUAL FISH (POECILIOPSIS, POECILIIDAE). Evolution, 28(2): 306-319.

18337. Hoffman, G. L. (U.S. Fish and Wildlife Serv., Eastern Fish Disease Lab., Kearneysville, West Virginia 25430). 1974. DISINFECTION OF CONTAMINATED WATER BY ULTRAVIOLET IRRADIATION, WITH EMPHASIS ON WHIRLING DISEASE (Myxosoma cerebrales) AND ITS EFFECT ON FISH. Trans. Amer. Fish. Soc., 103(3): 541-550.

Rainbow trout fry developed whirling disease upon exposure to water contaminated with Myxosoma cerebrales. When similarly contaminated water was irradiated with 2537 Angstrom units of ultraviolet light at dosages of 35,000, 43,000, and 112,000 microwatt sec/cm², infection of fry was prevented. The minimum effective dosage was not determined in the present experiments. High mortality and a 61% growth inhibition of survivors occurred in the infected fry. (Auth.)

18338. Korn, Sid, and Russell Earnest (NMFS, Tiburon Fish. Lab., Tiburon, California 94920). 1974. ACUTE TOXICITY OF TWENTY INSECTICIDES TO STRIPED BASS, Morone saxatilis. Calif. Fish Game, 60(3): 128-131; NOAA Marine Fisheries Abstracts, 27(10): p. 32.

The acute toxicity of 20 insecticides to juvenile striped bass was determined in saline water (28 ‰ to 30 ‰, depending upon the test). All bioassays were 4-day tests using proportional diluters described by D. Mount and W. Brungs [Water Research 1, 21-29 (1967)]. The toxicities of the insecticides to striped bass were as follows (expressed as Median Lethal Concentration (TL₅₀) values, µg/l): Endrin, 0.094; Endosulfan, 0.1; DDT, 0.53; Dursban 0.58; DDD, 2.5; Heptachlor, 3; Methoxychlor, 3.3; Toxaphene, 4.4; Aldrin, 7.2; Lindane, 7.3; Chlordane, 11.8; Malathion, 14; Parathion, 17.8; Dieldrin, 19.7; E.P.N., 60; Fenthion, 453; Dibrom, 500; Methyl Parathion, 790; Carbaryl, 1,000; and abate, 1,000.

18339. Shepherd, B. G. (Inst. of Animal Res. Ecol., Univ. of Br. Columbia, Vancouver, Brit. Columbia, Canada). 1974. ACTIVITY LOCALIZATION IN COASTAL CUTTHROAT TROUT (Salmo clarki clarki) IN A SMALL BOG LAKE. J. Fish. Res. Board Can., 31(7): 1246-1249.

Skindiving observations, ultrasonic tracking, and mark-recapture techniques indicated that coastal cutthroat trout (Salmo clarki clarki) in a small coastal bog lake have, but do not defend, fixed focal points of activity. (Auth.)

18340. Ward, F. J., and G. G. C. Robinson (Dept. of Zool., Univ. of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2). 1974. A REVIEW OF RESEARCH ON THE LIMNOLOGY OF WEST BLUE LAKE, MANITOBA. J. Fish. Res. Board Can., 31(5): 977-1005.

An interdisciplinary research program on the West Blue Lake ecosystem is reviewed. The composition, seasonal occurrence, abundance, and primary productivity of the phytoplankton are reported. In spring "net" phytoplankton diversity and abundance were highest with diatoms predominating. In summer Anabaena spiroides and Aphanizomenon flos aquae were a major component. During winter both cell numbers and species diversity declined. Cyclotella bodanica became dominant. Average summer phytoplankton primary productivity approximated $320 \text{ mg C m}^{-2} \text{ day}^{-1}$ in both 1971 and 1972. Average daily estimates (exclusive of zooplankton) of organic carbon in the euphotic zone during summer periods in 1971 and 1972 were, respectively, 5 and 8 g C m^{-2} . Kinetic parameters for the bacterial uptake of 11 dissolved organic substrates are reported. Values V_{max} ranged from $0.003 \text{ mg C m}^{-3} \text{ h}^{-1}$ for formic acid to $0.115 \text{ mg C m}^{-3} \text{ h}^{-1}$ for lactic acid; turnover times from 8 h for malic acid to 950 h for glycolic acid, and $(K_m + S)$ values from $0.288 \text{ mg C m}^{-3}$ for malic acid to $47.883 \text{ mg C m}^{-3}$ for glucose. A relation between V_{max} values and plated bacterial counts is described for six organic acids. Evidence for proliferation and adaptation of bacteria in sample bottles is presented and the absence of photoheterotrophy described. Potential bacterial production during the summer of 1972 ranged from $18.24 \text{ mg C m}^{-2} \text{ day}^{-1}$ to $67.44 \text{ mg C m}^{-2} \text{ day}^{-1}$. The relationship between this production and temperature ($Q_{10} = 3.129$) is described. "Filtration effect," as a source of error, in measuring glucose uptake is probably an artifact. Generally, Cyclops bicuspidatus was more abundant than Diaptomus siciloides. Both were relatively scarce in summer. Daphnia pulicaria were usually most abundant in spring and early summer, and persisted at low levels during winter. Largest animals (over 2.0 mm long) with high relative caloric content ($\approx 9000 \text{ cal g}^{-1}$) predominated in fall, winter, and early spring when reproduction was minimal. No fish species reside permanently in the pelagic zone of West Blue Lake, but age 0 fry of Perca flavescens inhabited the epilimnion during July and early August and fed almost exclusively on D. pulicaria. In contrast, age I and older perch consumed a variety of, principally, littoral organisms. Walleye, Stizostedion vitreum vitreum, over 25 cm in length put on most of their annual growth in length and weight during the summer, when maximum production also occurred. Perch fry and larger perch were an important food for walleyes. (Authors)

18341. Block, Ronald M. (Ecosystems Dept., Battelle Pacific Northwest Lab., Richland, Washington 99352). 1974. EFFECTS OF ACUTE COLD SHOCK ON THE CHANNEL CATFISH. In: Thermal Ecology, J. W. Gibbons and R. R. Sharitz (editors). AEC Symposium Series (CONF 730505), pp. 109-118.

After acclimation at 30°C channel catfish were exposed to acute cold shock at 10°C . Results indicated a slight increase in plasma osmolarity and chloride ions during the first 10 min of exposure. After 24 hr there was a rapid decline in osmolarity and chloride concomitant with increased plasma glucose and tissue water. Glucose levels were elevated by 281%, and plasma osmolarity and chloride decreased 34% and 55%, respectively, after 45 hr of exposure to 10°C . On return to acclimation temperature, the plasma concentrations of glucose, chloride, and osmolarity gradually returned to control values over a 4-day period. A mechanism for cold-shock death is discussed along with possible applications for monitoring toxic stress that produces osmoregulatory failure in fish. (Auth.)

18342. Sadzikowski, Mark R., and Dale C. Wallace (Dept. of Biol., E. Michigan Univ., Ypsilanti, Michigan 48197). 1974. THE INCIDENCE OF Lironeca ovalis (Say) (CRUSTACEA, ISOPODA) AND ITS EFFECTS ON THE GROWTH OF WHITE PERCH, Morone americana (Gmelin), IN THE DELAWARE RIVER NEAR ARTIFICIAL ISLAND. Chesapeake Science, 15(3): 163-165.

More than 1400 white perch from the Delaware River near Artificial Island were routinely examined for Lironeca ovalis (Say). When present, L. ovalis was found within the gill chamber. Of the fish examined only 24 (1.7%) were parasitized. Most of these were less than three years old. The presence of parasites apparently results in reduced growth. (Authors)

18343. Platts, W. S. (USDA, Forest Serv., 316 East Myrtle St., Boise, Idaho 83706). 1974. GEOMORPHIC AND AQUATIC CONDITIONS INFLUENCING SALMONIDS AND STREAM CLASSIFICATION WITH APPLICATION TO ECOSYSTEM CLASSIFICATION. Surface Environ. and Mining, U.S. Forest Serv., 145 Grand Ave., Billings, Montana, 199 p. Copies free on request.

Investigations were conducted from July 1970 through September 1972 of (1) the physical structure of aquatic environments in granitic, mountainous lands in Idaho, (2) the relationship between physical stream structure and fish populations, (3) the influence of geomorphic process of aquatic ecosystems, (4) the relation of order within landforms in relation to uniformity in aquatic environments, and (5) the potential for classifying aquatic environments from land classification systems. A 397 square mile area in the upper south fork of the Salmon River watershed was stratified into four geologic process groups and 12 geomorphic types. Within that area, 38 streams were studied by analyzing 2,482 transects for physical aquatic and streambank environments, while 291 areas were investigated as to fish populations. The streams had distinguishing structural features that had resulted from the influences of geomorphic processes. In other words, streams that drained similar lands had been formed by similar processes. Such streams will therefore be relatively uniform in structure. The results of the two-year study allow classification of aquatic environments within the granitic areas of the Idaho Batholith to the geologic process group level. Some specific environments can now be classified to the geomorphic type level. Some areas of each stream studied had been dominated by one type of external variable such as glaciation. Multivariate control from geomorphic processes, however, exercised the most influence on general stream conditions. Spatial differences in dissolved and suspended substances in the streams appeared to depend on the degree of decomposition of bedrock and possibly on the elevation of the channel. Time, as related to stream flow movement through the drainage, had little influence. In turn, certain aquatic structural characteristics controlled the density of fish populations and the composition of fish species. Stream depth, width, and the elevation of the stream channel were the most important such characteristics, with salmonids apparently adapted to almost all streams in these high elevation granitic lands. Variations in water chemistry did not seem correlated with the density of fish populations. The fish population total density decreased or increased in a uniform manner as certain variables in the aquatic structure changed. Some individual fish species, however, responded in an opposite manner and certain species showed no correlation. The variables that described the structure of the study streams often proved to be directly related. If one changing variable were identified, most other structural variables responded in a predictable manner. (Auth.)

18344. Shomura, Richard S., and Francis Williams (Editors). 1974. PROCEEDINGS OF THE INTERNATIONAL BILLFISH SYMPOSIUM KAILUA-KONA, HAWAII, 9-12 AUGUST 1972. PART 2. REVIEW AND CONTRIBUTED PAPERS. NOAA Tech. Report NMFS SSRF-675, 335 p.

18345. Prinslow, Thomas E., Ivan Valiela, and John M. Teal (Boston Univ. Mar. Program, Mar. Biol. Lab., Woods Hole, Massachusetts). 1974. THE EFFECT OF DETRITUS AND RATION SIZE ON THE GROWTH OF Fundulus heteroclitus (L.) J. Exp. Mar. Biol. Ecol., 16(1): 1-10.

In a laboratory experiment using juvenile killifish, Fundulus heteroclitus L., detritus addition to a commercial fish food diet of 0, 2, 4, 6, 7, 10 and 14% dry body weight/day did not significantly affect the growth of Fundulus when compared with replicate groups not receiving detritus. Even though Fundulus ingested detritus, they did not apparently use it for maintenance or growth. The fish required at least a daily ration of commercial fish food of 4-6% dry body weight for maintenance. The ash content of fish fed at diets of fish food below 4% dry weight/day increased, and the C/N ratio decreased, indicating the inadequacy of these rations. Fish grew almost at field rates at higher amounts of commercial fish food. When feeding in the field, fish at above-maintenance rations must exert a strong influence on prey populations. (Authors)

18346. Duthie, H. C., and M. L. Ostrofsky (Dept. of Biol., Univ. of Waterloo, Waterloo, Ontario, Canada N2L 3G1). 1974. PLANKTON, CHEMISTRY, AND PHYSICS OF LAKES IN THE CHURCHILL FALLS REGION OF LABRADOR. J. Fish. Res. Board Can., 31(6): 1105-1117.

Of 10 lakes and a reservoir in the Churchill Falls region of western Labrador studied in 1970-71, nine lakes were 12 m or less deep, humic, thermally unstratified, and had Secchi disc transparencies between 3.5 and 8.25 m. Maximum surface temperatures of 16-17 C in the nine lakes were generally reached by mid-August. Michikamau Lake (area 1980 km², depth 84 m) rarely exceeded 12 C and had a Secchi disc transparency of 13 m. Conductivities and alkalinities (as CaCO₃) ranged from about 13 µmho/cm and less than 6.5 mg/liter, for lakes draining granite, gneiss, or quartz bedrock, to about 30 and 15, for those draining gabbro or slate. Maximum live phytoplankton biomasses in 1970 ranged from 70 mg/m³, in Michikamau Lake, to 739 mg/m³, in Ossokmanuan Reservoir, and, in general, there was a positive correlation with conductivity. Diatoms were the most abundant group, in particular Asterionella formosa, Tabellaria fenestrata, and Rhizosolenia eriensis; however, flagellated Chrysophyta, mainly species of Dinobryon, were more abundant in the reservoir than in the natural lakes. Predominant zooplankters included Diaptomus minutus, Cyclops scutifer, Holopedium gibberum, Daphnia longiremis, D. galeata mendotae, and Bosmina coregoni. Maximum seasonal standing crops ranged from 1600 to 8910 individuals/m³, with the highest densities being found in the reservoir. The chemical and biological data suggested that the reservoir 8 yr after filling, showed little evidence of trophic upsurge and was possibly entering a period of trophic depression. (Authors)

18347. Cooper, John E., and Robert A. Kuehne (T. H. Morgan School of Biol. Sci., and Inst. of Speleology, Univ. of Kentucky, Lexington, Kentucky 40506). 1974. Speoplatyrhinus poulsoni, A NEW GENUS AND SPECIES OF SUBTERRANEAN FISH FROM ALABAMA. Copeia No. 2, pp. 486-493.

18348. Ueyanagi, Shoji (Far Seas Fish. Res. Lab., Shimizu, Japan). 1974. A REVIEW OF THE WORLD COMMERCIAL FISHERIES FOR BILLFISHES. NOAA Tech. Report NMFS SSRF-675, pp. 1-11.

This report gives a general "overview" of the commercial fisheries for billfishes. The present world production of billfishes is approximately 100,000 tons per year, of which more than 90% is taken by the tuna longline fishery. Japan alone produces about 70% of the world's catch of billfishes and is the principal consumer nation of these fish. Although billfishes account for only about 18% of the longline catches, they are presently of considerable importance, especially among the fishery products utilized in Japan. This report discusses the value and utilization of billfishes in Japan, and describes how billfishes have gained status as a quality fish, commanding prices comparable to the tunas. In addition, the expansion of the longline fishery is described, showing that by 1965 the fishery had covered the entire distributional range of the billfishes. Catch and effort data for billfishes indicate that 1) swordfish is the only species which has shown an increase in landings in recent years, 2) blue marlin landings have decreased in recent years in the South Pacific, Atlantic, and to a slightly lesser degree, also in the Indian Ocean, and 3) the catch of the striped marlin has fluctuated greatly from year to year. (Auth.)

18349. Wood, Chris M. (School of Biol. Sci., Univ. of East Anglia, Norwich, NOR88C, England). 1974. MAYER WAVES IN THE CIRCULATION OF A TELEOST FISH. J. Exp. Zool., 189(2): 267-274.

Regular oscillations in arterial blood pressures identical to mammalian Mayer waves were recorded in unanaesthetized trout (Salmo gairdneri). The waves were associated with hemorrhage, were caused by fluctuations in systemic vascular resistance, and were sometimes accompanied by fluctuations in cardiac output of opposite phase. Alpha-adrenergic blockade eliminated the phenomena; muscarinic cholinergic blockade was ineffective. The existence of Mayer waves provides evidence for a nervous control of vasomotor tone in teleosts. (Auth.)

18350. Tuunainen, Pekka, and Kai Westman (Finnish Game and Fish. Res. Inst., Fish. Div., Helsinki, Finland). 1973. ON THE FISHERIES RESEARCH IN FINLAND. Reprint from *Ichthyologia*, 5(1): 169-178.

Finland has about 3 million hectares of inland waters and over 2 million hectares of brackish water are within the fishing borders. About 15% of the water area has been polluted by urban and industrial effluents. This, together with the damming of the big rivers and the regulation of the great lakes has caused remarkable damages to the valuable fish stocks, especially anadromous and catadromous fish. The annual catches from the inland waters are estimated to be about 6-8 kgs per hectare the total catch being about 80-90 million kgs per year during the last years. The most important fish species caught in Finland are Baltic herring, perch, pike and vendace. The fish farms have produced about 1 million kgs of rainbow per year for consumption. The annual import of fish and fish products is equal to about 250 million kgs expressed as fresh fish. In the last ten years the number of fishermen increased rapidly being now about 1 million. Of these about 8,000-9,000 are commercial and the rest recreational fishermen or people who carry out household fishing. In other words, every fourth person in Finland is a fisherman. The facts mentioned above have directed the fisheries to the problems of management of the declining valuable fish stock, habitat improvement, the introduction of new species and to the intensification and rationalization of the exploitation of the existing resources. The farming of salmonids, mainly rainbow trout for consumption and salmon and brown trout for introductions, as well as the study of the crayfish are also fields where intensive research has been carried out during recent years. Studies on production problems of different kinds of waters and on other subjects concerned with the rational exploitation of fish stocks have been started in order to organize the management and utilization of fish stock. Especially, extensive ecosystem studies are becoming popular. (Authors' summ.)

18351. Engett, Mary Ellen, and Lee C. Thorson (Scientific Publications Staff, NMFS, NOAA, Seattle, Washington 98105). 1974. FISHERY PUBLICATIONS, CALENDAR YEAR 1973: LISTS AND INDEXES. NOAA Tech. Report NMFS CIRC-390, 14 p.

18352. Barnabé, Gilbert (Sta. de Biol. Mar. et Lagunaire de l'Univ. des Sci. et Techniques du Languedoc 1, Quai de Bosc, F 34200 Sète, France). 1973. CONTRIBUTION TO THE KNOWLEDGE OF GROWTH AND SEXUALITY OF THE BASS (*Dicentrarchus labrax* L.) IN SÈTE WATERS. [Contribution a la connaissance de la Croissance et de la Sexualité du Loup (*Dicentrarchus labrax* L.) de la région de Sète]. Ann. Inst. Oceanogr., Paris, 49(1): 49-75.

Sampling of the population of *Dicentrarchus labrax* has been done partly with spear diving catches, and partly with data collected by professional fishermen. Cross-checking the results shows that underwater fishing is a new investigational method. The growth of the Sète bass is the highest registered until now, although it is active for seven months a year only. Variations in the gonadosomatic ratio, the hepatosomatic ratio and adiposity have made it possible to define the development of sexuality according to age and to the annual seasonal cycle, and also to bring to light some interactions between metabolism and sexuality. These interactions differ according to sex and do not characterize immature animals: from a physiological point of view, the population is composed of three groups: immature, males and females. (Auth.)

18353. Lenarz, William H., and Eugene L. Nakamura (Southwest Fish. Center, NMFS, NOAA, La Jolla, California 92037). 1974. ANALYSIS OF LENGTH AND WEIGHT DATA ON THREE SPECIES OF BILLFISH FROM THE WESTERN ATLANTIC OCEAN. NOAA Tech. Report NMFS SSRF-675, pp. 121-125.

Estimates of parameters of relations among weight, girth, total length, fork length, body length, trunk length, and caudal spread were made for blue marlin, white marlin, and sailfish captured in the western Atlantic. Some sexual differences were found. (Authors)

18354. Eckhert, Curtis D., and Arthur R. Kemmerer (Dept. of Agric. Biochem., Univ. of Arizona, Tucson, Arizona 85721). 1974. EFFECT OF VITAMIN A AND METHIONINE ON GROWTH AND AMINO ACID COMPOSITION OF BODY PROTEIN IN RAINBOW TROUT FINGERLINGS. J. Nutr., 104(7): 865-870; NOAA Marine Fisheries Abstracts, 27(10): p. 21.

In fish farming and in the early stages of culturing game fish, commercial feeds which provide optimum growth and body composition are needed. Other investigators of fish diets reported that high levels of vitamin A can lead to hyper-*vitaminosis* A in fish. This is manifested by decreased growth and higher levels of body fat and cholesterol. Additionally, methionine supplemented diets, containing soy protein or casein, increased plasma vitamin A levels in rats. In this present report, a study of the effects of vitamin A and methionine upon the growth rate and amino acids of fingerling rainbow trout is discussed. Rainbow trout that had been maintained on a commercial diet were placed, in groups of five, into plastic tanks containing 20 l of water at 12.5°C. Fish in four tanks were fed a commercial diet, and fish in four tanks were fed a purified diet. Growth rates were compared over a 5-week period to ensure that the purified diet would support growth. Feeding trials were then set up with the purified diet containing three levels of vitamin A palmitate: 1,000, 2,000, and 4,000 IU per 100 g; and three levels of methionine: 500, 1,000, and 2,000 mg per 100 g. Each of the nine diets was fed to the fingerlings over a 3-week period. There was no significant difference in weight gain between fish on the commercial or purified diets. The fish on the diets containing supplemented vitamin A and methionine were analyzed for percentage growth, dry weight, and protein, and ratio of bound amino acids to free amino acids. Diets low in methionine produced decreasing growth, as the vitamin A increased, accompanied by decreasing dry weight. The same pattern was observed in diets low in vitamin A with increasing methionine. At the highest level of vitamin A, increased percentage growth and dry weight occurred with increasing levels of methionine, but percentage protein decreased. The ratio of bound/free amino acids was depressed by increasing either the vitamin A level to 2,000 or 4,000 IU/100 g of diet at a methionine level of 500 mg/100 g, or by increasing the methionine level to 1,000 or 2,000 mg/100 g at a vitamin A level of 1,000 IU/100 g. The decrease in the ratio was due to a large increase in free amino acids while the bound amino acids increased slightly. The authors suggest that the results of these feeding trials indicate that rations for young trout should be balanced in the content of methionine and vitamin A to maintain proper growth and amino-acid metabolism.

18355. Jeng, Sen Shyong, and Hsiu Wan Lo (Inst. of Zool., Acad. Sinica, Nankang, Taipei, Taiwan 115, Republic of China). 1974. HIGH ZINC CONCENTRATION IN COMMON CARP VISCERA. Bull. Jap. Soc. Sci. Fish., 40(5): 509.

18356. McComish, Thomas S., Richard O. Anderson, and F. Glenn Goff (Dept. of Biol., Ball State Univ., Muncie, Indiana 47306). 1974. ESTIMATION OF BLUEGILL (*Lepomis macrochirus*) PROXIMATE COMPOSITION WITH REGRESSION MODELS. J. Fish. Res. Board Can., 31(7): 1250-1254.

Dry weight, protein, fat, and ash proximates were determined for 100 individual laboratory reared bluegill (*Lepomis macrochirus*). Regression analysis using forms of length and weight provided models for prediction of proximates. Percent dry weight was a linear function of coefficient of condition ($r = 0.866$). Natural logarithm of ash was a linear function of natural logarithm of length ($r = 0.997$). Percent fat was a function of coefficient of condition and natural logarithm of length ($r = 0.796$). Percent protein was a function of coefficient of condition and natural logarithm of length times natural logarithm of weight ($r = 0.768$). The regression models, based only on length and live weight of fish, allowed accurate prediction of bluegill proximate composition for a laboratory fish population raised on chironomid larvae. (Authors)

18357. Carter, Neal M. 1974. JOURNAL OF THE FISHERIES RESEARCH BOARD OF CANADA - INDEX TO PUBLICATIONS FOR 1973. J. Fish. Res. Board Can., Vol. 30, Index 1973, pp. 2539-2691.

18358. Eisler, Ronald (U. S. Environ. Protection Agency, Nat. Mar. Water Qual. Lab., Narragansett, Rhode Island 02882). 1974. RADIOCADMIUM EXCHANGE WITH SEAWATER BY Fundulus heteroclitus (L.) (PISCES: CYPRINODONTIDAE). J. Fish Biol., 6(5): 601-612.

Mummichogs, Fundulus heteroclitus (L.) accumulated Cd 115m (NO₃)₂ from synthetic seawater solutions during a period of 25 days, but the rate of whole body accumulation decreased with increasing concentrations of stable Cd²⁺ in the medium. Viscera were the major repository of Cd 115m during uptake, especially gastrointestinal tract and to a lesser extent liver. Loss in whole body radioactivity over a post-treatment interval of 180 days in cadmium-free seawater was about 90%, with gallbladder and especially liver most influential in the excretion processes; this pattern was unchanged by the level of stable Cd²⁺ present in the medium during uptake. The significance of this and other observations in terms of field monitoring of cadmium utilizing teleosts as indicators is discussed. (Auth.)

18359. Stanley, Jon G. (Fish Farming Exp. Sta., P.O. Box 860, Stuttgart, Arkansas 72160). 1974. NITROGEN AND PHOSPHORUS BALANCE OF GRASS CARP, Ctenopharyngodon idella, FED ELODEA, Egeria densa. Trans. Amer. Fish. Soc., 103(3): 587-592.

The herbivorous grass carp fed winter elodea exhibited a negative nitrogen balance in metabolism, suggesting that food having a higher protein content would be required for normal growth. About a third of the phosphorus contained in food was retained; hence, a combination of aquatic plants and grass carp might afford an effective biological method for removing phosphorus from water. Water quality was altered by the excretion of ammonium and orthophosphate by grass carp. Even though the grass carp might be useful in removing some phosphorus from water, its principal impact was to increase the rate of recycling of nitrogen and phosphorus. (Auth.)

18360. Vollenweider, R. A., M. Munawar, and P. Stadelmann (Dept. of the Environ., Canada Centre for Inland Waters, Burlington, Ontario, Canada L7R 4A6). 1974. A COMPARATIVE REVIEW OF PHYTOPLANKTON AND PRIMARY PRODUCTION IN THE LAURENTIAN GREAT LAKES. J. Fish. Res. Board Can., 31(5): 739-762.

Species composition of phytoplankton in the Laurentian Great Lakes, its biomass concentration, and its physiological activity measured as photosynthesis related to eutrophication, are reviewed and discussed. (Authors)

18361. Dockray, Graham J. (Physiol. Lab., Univ. of Liverpool, Liverpool L69 3BX, England). 1974. EXTRACTION OF A SECRETINLIKE FACTOR FROM THE INTESTINES OF PIKE (Esox lucius). Gen. Comp. Endocrinol., 23(3): 340-347.

18362. Eldridge, Maxwell B., and Paul G. Wares (NOAA, NMFS, Tiburon Fish. Lab., Tiburon, California 94920). 1974. SOME BIOLOGICAL OBSERVATIONS OF BILLFISHES TAKEN IN THE EASTERN PACIFIC OCEAN, 1967-1970. NOAA Tech. Report NMFS SSRF-675, pp. 89-101.

From 1967 through 1970 sport-caught billfishes were sampled at Mazatlan, Sinaloa; and Buena Vista, Baja California, and at San Diego, California. Lengths, weights, morphometrics, meristics, and gonad data were gathered on a total of 2,056 striped marlin, 821 sailfish, 61 blue marlin, and 1 black marlin. This paper presents information on reproduction, average length and condition factor, food habits for 1970, and notes on parasites. Developing gonads were found only in the Mexican fish. Our data on reproduction indicated that both striped marlin and sailfish spawn once per year with peak spawning activity probably in June and July. There is also the possibility that sailfish spawn in other months. First maturity in striped marlin and sailfish occurred in the 155-165 cm eye-fork length class. Fecundity estimates ranged from 2 to 5 million eggs for four sailfish and from 11 to 29 million eggs for three striped marlin. It appears that striped marlin move offshore from the Mexican coastline to spawn while sailfish remain closer to shore. (Authors)

18363. Dickson, Kenneth L., Albert C. Hendricks, John S. Crossman, and John Cairns, Jr. (Biol. Dept. and Center for Environ. Studies, Virginia Polytechnic Inst. and State Univ., Blacksburg, Virginia 24061). 1974. EFFECTS OF INTERMITTENTLY CHLORINATED COOLING TOWER BLOWDOWN ON FISH AND INVERTEBRATES. *Environ. Sci. Technol.*, 8(9): 845-849.

An in situ bioassay was conducted to evaluate the effects of intermittently chlorinated cooling tower blowdown from Appalachian Power Co.'s Carbo, Virginia, plant on bluegill sunfish (*Lepomis macrochirus* Raf.) and a snail (*Anculosa* sp.). Cooling towers at the plant were treated for slime control with 0.75 mg/l of chlorine for 3 min four times a day. The cooling tower blowdown was discharged to the Clinch River. Caged fish and invertebrates were placed at various distances downstream from the blowdown discharge and observed for 96 hr. Amperometric determinators for both free and total chlorine were made at 10-min intervals at selected stations throughout the study period. No fish deaths occurred which could be attributed to the blowdown discharges. However the blowdown was acutely toxic in 72 hr to 50% of the snails exposed to less than 0.04 ppm total residual chlorine for less than 2 hr/day and to 80 µg/l copper plus other blowdown constituents. Nevertheless the impact of the cooling tower blowdown on the total ecology of the Clinch River was probably of no importance since the observed mortalities were restricted to an area extended not over 20 ft from the left bank and 800 ft downstream. (Authors)

18364. Thorpe, Alan, and Bernard W. Ince (Dept. of Zool. and Comp. Physiol., Queen Mary College, London Univ., London, England). 1974. THE EFFECTS OF PANCREATIC HORMONES, CATECHOLAMINES, AND GLUCOSE LOADING ON BLOOD METABOLITES IN THE NORTHERN PIKE (*Esox lucius* L.). *Gen. Comp. Endocrinol.*, 23(1): 29-44.

18365. De Sylva, Donald P. (Univ. of Miami, Rosenstiel School of Mar. and Atmospheric Sci., Miami, Florida 33149). 1974. A REVIEW OF THE WORLD SPORT FISHERY FOR BILLFISHES (ISTIOPHORIDAE AND XIPHIIDAE). NOAA Tech. Report NMFS SSRF-675, pp. 12-33.

Sport fishing is conducted for billfishes (Istiophoridae and Xiphiidae) in nearly all warm oceans, primarily in tropical and subtropical seas. In probable order of descending catch rate, the principal species caught by anglers are sailfish, white marlin, blue marlin, striped marlin, black marlin, swordfish, and longbill spearfish; the shortbill and Mediterranean spearfishes are rarely taken by anglers. Important sport fisheries are presently concentrated from Massachusetts to North Carolina and about Bermuda, southeastern Florida, the northern and northeastern Gulf of Mexico, the Bahamas, the larger islands of the Caribbean, Venezuela, the eastern tropical Pacific between southern California and Chile, Hawaii, New Zealand and eastern Australia, Kenya to Cape Town, South Africa, Ivory Coast to Senegal, West Africa, and off Portugal, Spain, and Italy. In some regions maximum angling effort coincides with maximum availability of billfish, while in others, especially in the western North Atlantic, maximum angling pressure is correlated with angling tournaments which in turn relate to summer vacations of tourists and the tendency of most anglers to fish only during the day and when the weather is favorable. Angling for billfish during the "off-season" may well produce good results in areas which usually are heavily fished only at certain periods. New billfishing regions probably can be developed, but this requires the assistance of local governments to provide or ensure adequate sportfishing vessels, docks, bait, and, especially, qualified captains and crews. Because of the relative inefficiency of the gear used by anglers to catch billfish, it is unlikely that angling can deplete the billfish stocks, other factors such as natural environmental fluctuations, pollution, or commercial fishing being equal. There is evidence that commercial fishing in the eastern Pacific is affecting the sport catches of sailfish and striped marlin. Based on commercial catch data, the mean size of sailfish and striped marlin and their hooking rate have decreased. In the Caribbean the catch rate of blue marlin and white marlin by commercial fishermen has decreased; this phenomenon may be attributed to heavy commercial fishing pressure from longline fleets. The economic value of the billfish sport fishery is extremely high

to local communities which support angling activities. In spite of some aesthetic feelings which promote releasing of billfish which are not tagged, it would appear that catches by anglers could be retained for human consumption without seriously depleting the stocks, thus further contributing to local economy. Sport fishing for billfishes poses special problems because of the complexity, expense, expertise required, and lack of basic information on the fisheries and the fishermen. Possible solutions to these are discussed. (Auth.)

18366. Lea, Robert N. (California Dept. of Fish and Game, Mar. Res. Region, Monterey, California 93940). 1974. FIRST RECORD OF PUGET SOUND SCULPIN, Artedius meanyi, FROM CALIFORNIA. J. Fish. Res. Board Can., 31(7): 1242-1243.

Artedius meanyi was collected on four occasions from Arena Cove, California. These collections represent the most southerly record of A. meanyi and its first known occurrence in California waters. (Auth.)

18367. Stevenson, Michael M., Gary D. Schnell, and Robert Black. 1974. FACTOR ANALYSIS OF FISH DISTRIBUTION PATTERNS IN WESTERN AND CENTRAL OKLAHOMA. Systematic Zoology, 23(2): 202-218.

The distribution patterns of western and central Oklahoma fishes were analyzed, utilizing factor analytical techniques, to determine generalized patterns and their correlation with certain environmental variables. Twenty-seven drainage units of the major Arkansas and Red river tributaries were scored for the presence or absence of each of 53 species and values for 13 environmental variables. Six factor groups were obtained through oblique rotation of principal axes that were factored from the correlation matrix of the variables. These six associations were judged biologically meaningful and provide insight into the limiting factors affecting the Oklahoma fish fauna. The relative effects of historical and environmental components on current distribution groupings are discussed and some predictions are made concerning future faunal changes. (Authors)

18368. Fierstine, Harry L. (Biol. Sci. Dept., Calif. Polytechnic State Univ., San Luis Obispo, California 93407). 1974. THE PALEONTOLOGY OF BILLFISH - THE STATE OF THE ART. NOAA Tech. Report NMFS SSRF-675, pp. 34-44.

The major osteological features are described for living billfishes. All billfish remains are reviewed critically and some questionable forms are placed in Xiphioidae Incertae Sedis (uncertain status). The remaining xiphioids are placed into three families: Istiophoridae, Xiphiidae, and Xiphiorhynchidae. A new undescribed xiphiid from Mississippi shows that the billfish lineages must have diverged prior to the Eocene. Areas of research are suggested that will help place the paleontological studies on a more secure foundation. (Auth.)

18369. Zeitoun, Ibrahim H., Duane E. Ullrey, and Peter I. Tack (Dept. of Fish. & Wildl., Mich. State Univ., East Lansing, Michigan 48824). 1974. EFFECTS OF WATER SALINITY AND DIETARY PROTEIN LEVELS ON TOTAL SERUM PROTEIN AND HEMATOCRIT OF RAINBOW TROUT (Salmo gairdneri) FINGERLINGS. J. Fish. Res. Board Can., 31(6): 1133-1134.

Seven separate diets ranging from 30 to 60% protein in 5% increments were fed for 10 wk to duplicate groups of rainbow trout, Salmo gairdneri, fingerlings maintained at 10 and 20 ‰ salinity. Water salinity and dietary protein concentration did not significantly influence total serum protein. Hematocrit increased substantially with salinity (35.3% for fish at 10 ppt and 39.1% for those at 20 ppt), whereas different levels of dietary protein were of minor consequence. (Authors)

18370. Cross, T. F., and M. C. Lyes (Dept. of Zool., University College, Cork, Ireland). 1974. A FIRST NORTH-EASTERN ATLANTIC RECORD OF THE BLUEFISH Pomatomus saltatrix (L. 1758), (FAM. POMATOMIDAE). J. Fish Biol., 6(5): 659-660.

The capture of a specimen of the bluefish - Pomatomus saltatrix (L. 1748) off Ballycotton, Co. Cork, Ireland (Lat. 8°W, Long. 51°50'N) is reported. Some diagnostic features and measurements of the specimen are given. This would appear to be the first record of the species for the Eastern Atlantic, north of Spain.

18371. Zeitoun, Ibrahim H., Duane E. Ullrey, John E. Halver, Peter I. Tack, and W. T. Magee (Dept. of Fish. and Wildl., Mich. State Univ., East Lansing, Michigan 48824). 1974. INFLUENCE OF SALINITY ON PROTEIN REQUIREMENTS OF COHO SALMON (Oncorhynchus kisutch) SMOLTS. J. Fish. Res. Board Can., 31(6): 1145-1148.

Six purified diets ranging from 30 to 55% protein in 5% increments were fed for 10 wk to duplicate groups of coho salmon (Oncorhynchus kisutch) smolts maintained at 10 or 20 ‰ salinity. The data indicated that minimum protein requirements did not differ for fish at either salinity, and weight gain and protein retention levelled off after 40% protein in the diet was reached. Salinity had a minor effect on the criteria measured whereas the different dietary protein concentrations were of major consequence. The protein efficiency ratio (PER) of the casein diet containing 40% protein was 2.20 ± 0.11 whereas apparent net protein utilization (NPU) at the same level was 36.1 ± 1.8 . (Authors)

18372. Kennedy, C. R. (Dept. of Biol. Sci., Univ. of Exeter, England). 1974. A CHECKLIST OF BRITISH AND IRISH FRESHWATER FISH PARASITES WITH NOTES ON THEIR DISTRIBUTION. J. Fish Biol., 6(5): 613-644.

One hundred and sixty eight species of parasite are listed from 36 species of freshwater fish from Britain and Ireland, and notes on their distribution are provided. A list of hosts together with the parasites recorded from them is also given. Although almost twice as many species are listed as in the most recent published reference list, the parasite fauna of Britain appears to be considerably poorer in number of species than that of mainland Europe, and that of Ireland poorer still. The distribution of most species, apart from two endemic species and a very few which have clearly been introduced into Britain in recent years from America or the mainland of Europe, appears to show no peculiarities and is probably contiguous with that of their hosts. (Auth.)

18373. Nakamura, Izumi (Fish. Res. Sta., Kyoto Univ., Maizuru, Kyoto 625, Japan). 1974. SOME ASPECTS OF THE SYSTEMATICS AND DISTRIBUTION OF BILLFISHES. NOAA Tech. Report NMFS SSRF-675, pp. 45-53.

Until recently the classification of billfishes (Xiphiidae and Istiophoridae) was confused. Recent workers have consolidated the nominal species and reduced the number of species considerably. A key, with figures, is presented which includes two families, four genera, and 11 species. Makaira mazara is considered distinct from M. nigricans because of consistent differences in the pattern of the lateral line system. Tetrapterus platypterus is tentatively separated from T. albicans although existing differences are minor and could be referable to the sub-specific level. The worldwide distribution of billfishes is given; distributions are based primarily on data from the Japanese longline catch for 1964-69. (Auth.)

18374. Gardner, M. L. G. (Dept. of Biochem., Univ. of Edinburgh Med. School, Teviot Place, Edinburgh, EH8 9AG, Scotland). 1974. IMPAIRED OSMOREGULATION IN INFECTED SALMON, Salmo salar L. J. Mar. Biol. Assn. U.K., 54(3): 635-639.

The plasma osmotic pressure of salmon infected with Ulcerative Dermal Necrosis was significantly lower than that of apparently healthy fish. This depression in osmotic pressure appeared to be greater in fish which were in fresh water than in those in brackish water. Plasma sodium concentration was depressed correspondingly, and the relation between these and osmotic pressures suggested that the fall in osmotic pressure might be due to salt loss rather than water intake. Hypoproteinaemia in the infected fish was also confirmed. (Auth.)

18375. Worswick, Joseph M., Jr., and Michael T. Barbour (Great Lakes Fish. Lab., U.S. Fish & Wildl. Serv., P.O. Box 640, Ann Arbor, Michigan 48107). 1974. AN ELUTRIATION APPARATUS FOR MACROINVERTEBRATES. Limnol. and Oceanogr., 19(3): 538-540.

An inexpensive hydropneumatic apparatus screens macroinvertebrates from bottom samples containing silt, mud, or clay. The elutriator, an acrylic cylinder with screened windows, cemented on an upright plastic funnel, retains benthic fauna while the sediment is washed away. The apparatus yields clean samples and has reduced the time required to sort benthos sediments by more than 80%. (Authors)

18376. Kirk, William L. (Dept. of Zool., Southern Illinois Univ., Carbondale, Illinois 62901). 1974. THE EFFECTS OF HYPOXIA ON CERTAIN BLOOD AND TISSUE ELECTROLYTES OF CHANNEL CATFISH, Ictalurus punctatus (Rafinesque). Trans. Amer. Fish. Soc., 103(3): 593-600.

Channel catfish, Ictalurus punctatus (Rafinesque) exhibited changes in levels of muscle and blood electrolytes during recovery from short-term hypoxia. Ten minutes of confinement in water having zero mg/liter oxygen resulted in an acidosis characterized after 1 hr of recovery by elevated blood lactate, decreased blood pH, and an increase in plasma osmolality and hematocrit. Muscle water content was increased at this time. Later changes in these parameters appeared to be influenced by season or temperature. Plasma osmolality dropped below control levels in June and remained depressed after 36 hr of recovery. In August plasma osmolality fluctuated at levels above control values and had not returned to normal after 48 hr. These data indicate that electrolyte imbalance persists for many hours after blood lactate has declined to control levels and this imbalance may limit the fish's ability to tolerate further stress. (Auth.)

18377. Rohde, Fred C., Rudolf G. Arndt, and Johnson C. S. Wang (Ichthyol. Assoc., Inc., 100 S. Cass Street, Middletown, Delaware 19709). 1974. ADDITIONAL RECORDS OF THE LEAST BROOK LAMPREY, Ookelbergia aepyptera (Abbott), FROM THE DELMARVA PENINSULA. Chesapeake Science, 15(3): 154-155.

18378. Lieb, Andrew J., Donald D. Bills, and Russell O. Sinnhuber (Dept. of Food Sci. and Tech., Oregon State Univ., Corvallis, Oregon 97331). 1974. ACCUMULATION OF DIETARY POLYCHLORINATED BIPHENYLS (AROCOR 1254) BY RAINBOW TROUT (Salmo gairdneri). J. Agric. Food Chem., 22(4): 638-642; NOAA Mar. Fish. Abstracts, 27(10): p. 27.

Polychlorinated biphenyls (PCB's) are industrial chemicals that are widely distributed in the environment. This class of chemicals is persistent in the environment and accumulates in the food chain as do the organochlorine pesticides. Of the many species of fish and wildlife with accumulations of PCB's, those used for human consumption and animal feed are important because of possible adverse effects. This study was carried out to follow the accumulation of PCB's in rainbow trout and to determine any resulting adverse effects. A semi-synthetic diet in pellet form was fed to rainbow trout. PCB's were added to the salmon oil in the diet at a level of 15 p/m. At the start of the feeding trial, the trout were 14 weeks old. The PCB diet was fed to 240 fish, and 160 fish were maintained on the PCB-free control diet. Samples of fish were taken every 4 weeks for 32 weeks, and then feeding was stopped. After 8 weeks of starvation, fish that had been on the diet containing PCB's were analyzed. The fish were homogenized, the lipids were extracted, and the PCB's were recovered from the lipids by cleanup procedures and gas chromatography. The liver, gills, stomach, muscle, and viscera were removed and examined for pathology and PCB's content. The levels of PCB's in the lipids of trout increased rapidly for the first 8 weeks and then tended to equilibrate at 95 p/m. The control fish lipids contained less than 1 p/m background PCB's. The concentration of PCB's in the fish remained stable, but the total amount of PCB's increased as the fish grew larger. The level of PCB's remained stable in the starved fish. This indicates that trout are unable to eliminate PCB's. The liver contained the lowest level of PCB's of the tissues examined. Microscopic examination indicated that there were no pathological changes in the tissues after exposure to PCB's, and growth was not inhibited.

18379. Association of Midwest Fish and Wildlife Commissioners. 1973. PROCEEDINGS OF THE 40TH ANNUAL CONVENTION HELD AT BISMARCK, NORTH DAKOTA, JULY 16-19, 1973. Assn. of Midwest Fish and Wildlife Commissioners, 118 p. plus reports and resolutions.

18380. Shireman, Jerome V. (Univ. of Southwestern Louisiana, Lafayette, La. 70501). 1974. PRELIMINARY EXPERIMENT ON STRIPED MULLET CULTURE IN FRESHWATER CATFISH PONDS. Prog. Fish-Cult, 36(2): p. 113.

18381. Haedrich, R. L., and S. O. Haedrich (Woods Hole Oceanogr. Inst., Woods Hole, Massachusetts 02543). 1974. A SEASONAL SURVEY OF THE FISHES IN THE MYSTIC RIVER, A POLLUTED ESTUARY IN DOWNTOWN BOSTON, MASSACHUSETTS. *Estuarine and Coastal Marine Science*, 2(1): 59-73.

Twenty-three species of marine fishes were taken in the Mystic River during surveys conducted with trawls and gillnets four times in a year. Winter flounder was the dominant species, with alewives and smelt abundant on a seasonal basis. These three species were present in all seasons. Others occurred less frequently with 17 species occurring only once. The fewest number of species, 6, was taken in August and the highest number, 11, in November. Diversity H (on numbers) ranged from a low of 0.33 in August to 1.03 in June; H (on weight) ranged from 0.12 in August to 0.75 in March. Standing crop (biomass) was 0.5 g/m² in June and averaged about 2 g/m² in August, November and March. During the warmest period, fishes tended to be found in the lower portions of the estuary but in winter they were concentrated upriver. Percent overlap in species composition between seasons is high through the summer, a period dominated by winter flounder, and is much lower from winter into spring, reflecting the increases in abundance due to spawning activities of smelt and alewives. Pooled annual diversity H is 1.19 (on numbers) and 0.71 (on weight). These values are at the low end of the scale assumed by this index when applied to fish communities. (Authors)

18382. Hanek, George, and Kalman Molnar (Dept. of Biol., Univ. of Waterloo, Waterloo, Ontario N2L 3G1, Canada). 1974. PARASITES OF FRESHWATER AND ANADROMOUS FISHES FROM MATAMEK RIVER SYSTEM, QUEBEC. *J. Fish. Res. Board Can.*, 31(6): 1135-1139.

In 224 fish of nine species from Matamek River system 38 genera of parasites were recovered (12 Protozoa, 3 Monogenea, 6 Digenea, 6 Cestoda, 6 Nematoda, 2 Acanthocephala, 3 Copepoda). Six genera of parasites were noted in Salmo salar, Salvelinus fontinalis harbored 17 genera, S. alpinus 5 genera, Osmerus mordax 4 genera, Anguilla rostrata 9 genera, Catostomus catostomus 8 genera, Apeltes quadracus 1 genus, Gasterosteus aculeatus 12 genera, and Pungitius pungitius 9 genera. (Authors)

18383. Williams, Ernest H., Jr. (Dept. of Fish. and Allied Aquacultures, Agric. Exp. Sta., Auburn Univ., Auburn, Alabama 36830). 1974. TWO NEW SPECIES OF Monobothrium (CESTODA: CARYOPHYLLAEIDAE) FROM CATOSTOMID FISHES OF THE SOUTHEASTERN UNITED STATES. *Trans. Amer. Fish. Soc.*, 103(3): 610-615.

Two caryophyllaeid cestodes are described, Monobothrium fossae sp. n. from the blacktail redhorse Moxostoma poecilurum (Jordan) and Monobothrium mackiewicz sp. n. from the Alabama hog sucker, Hymentelium etowanum (Jordan) from Alabama. M. ulmeri Calentine and Mackiewicz collected from the silver redhorse Moxostoma anisurum Robin and Raney in Lincoln County, Georgia constitutes a new locality record for the cestode, previously unknown south of Tennessee or east of Oklahoma. A table comparing the five North American species of Monobothrium is presented. (Auth.)

18384. Schuijf, A., and M. E. Siemelink (Lab. of Comp. Physiol., Jan van Galenstraat 40, Utrecht, The Netherlands). 1974. THE ABILITY OF COD (Gadus morhua) TO ORIENT TOWARDS A SOUND SOURCE. *Experientia*, 30(7): 773-775.

18385. Burton, William (Dept. of the Environ., Fish. and Mar. Service, Freshwater Inst., Winnipeg, Manitoba, Canada R3T 2N6). 1974. A SEMIAUTOMATIC RELEASE GEAR FOR GRABS AND CORERS. *J. Fish. Res. Board Can.*, 31(7): 1244-1246.

A semiautomatic release gear may be attached to grabs and corers. It eliminates the need for a messenger, and improves efficiency under drifting conditions. (Auth.)

18386. Paterson, W. D. (Dept. of the Environ. Fish. and Mar. Serv., Halifax Lab., Halifax, Nova Scotia B3J 2R3, Canada). 1974. BIOCHEMICAL AND SEROLOGICAL DIFFERENTIATION OF SEVERAL PIGMENT-PRODUCING AEROMONADS. J. Fish. Res. Board Canada, 31(7): 1259-1261.

A pigment-producing aeromonad isolated from Atlantic salmon (Salmo salar) was serologically and biochemically indistinguishable from Aeromonas liquefaciens ATCC 14715. Aeromonas salmonicida, whose presence in the Maritime Provinces of Canada has never been confirmed, was clearly differentiated from the pigmented strains of A. liquefaciens. (Auth.)

18387. Ueyanagi, Shoji (Far Seas Fish. Res. Lab., Shimizu, Japan). 1974. ON AN ADDITIONAL DIAGNOSTIC CHARACTER FOR THE IDENTIFICATION OF BILL-FISH LARVAE WITH SOME NOTES ON THE VARIATIONS IN PIGMENTATION. NOAA Tech. Report NMFS SSRF-675, pp. 73-78.

The larvae of fish species of billfishes (Istiophoridae) occurring in the Indian and Pacific Oceans - sailfish, Istiophorus platypterus; shortbill spearfish, Tetrapturus angustirostris; striped marlin, T. audax; blue marlin Makaira mazara; and black marlin, M. indica - have now been identified. The identification of these larvae has depended on such characters as the shape of the pectoral fin, pigmentation of the branchiostegal membrane, pigmentation of the lower jaw membrane, and head profile. Some problems in identification remain, however, as for example in the differentiation between very small larvae (under 7 mm) of striped marlin and blue marlin. Recent studies have resulted in additional diagnostic characters which differentiate between these two species, namely the differences in the pterotic and preopercular spines. The larvae of sailfish generally have pigment on the posterior half of the lower jaw, and this pigmentation is recognized to be species specific. There exist, however, some larvae of this species which lack this characteristic pigmentation, and the occurrence of these larvae seems to vary geographically from the more typical sailfish larvae. (Auth.)

18388. Gard, Richard, and Glenn A. Flittner (School of Forestry and Conserv., Univ. of Calif., Berkeley, California 94720). 1974. DISTRIBUTION AND ABUNDANCE OF FISHES IN SAGEHEN CREEK, CALIFORNIA. J. Wildl. Manage., 38(2): 347-358.

Elevational distribution and abundance of fishes in Sagehen Creek, California, were determined each August between 1952 and 1961 by the electric shocking and diversion and draining methods. Nine species of fishes were present in Sagehen Creek. Brook trout (Salvelinus fontinalis) only inhabited the headwaters. In the downstream direction, rainbow trout (Salmo gairdneri), Piute sculpin (Cottus beldingi), brown trout (Salmo trutta), mountain whitefish (Prosopium williamsoni), Tahoe sucker (Catostomus tahoensis), mountain sucker (Catostomus platyrhynchus), Lahontan redbelly (Richardsonius egregius), and speckled dace (Rhinichthys osculus) were progressively added to the fish fauna. Maximum diversity of species occurred near the mouth of the creek. Stream gradient and timing and severity of floods were respectively the most important environmental factors associated with elevational and temporal abundance of fishes. Over the 10-year period, distributions of most species were remarkably stable, but there were 3- to 10-fold fluctuations in numbers. This long-term record of distributions and standing crops of fishes may be useful in evaluating future studies on Sagehen Creek and elsewhere. (Authors)

18389. Youngs, William D. (Dept. of Nat. Res., Cornell Univ., Ithaca, New York 14850). 1974. ESTIMATION OF THE FRACTION OF ANGLERS RETURNING TAGS. Trans. Amer. Fish. Soc., 103(3): 616-618.

The reciprocal of the slope of the regression of force of total mortality on force of reported fishing mortality provides an estimate of the percent of tags returned from tagged fish which are caught. Necessary conditions for the validity of this procedure are presented. An example of the technique is given. (Auth.)

18390. Nelson, John T., Robert G. Bowker, and John D. Robinson (U.S. Fish and Wildl. Serv., Mammoth Spring Natl Fish Hatchery, Mammoth Spring, Arkansas 72554). 1974. REARING PELLET-FED LARGEMOUTH BASS IN A RACEWAY. Prog. Fish-Cult., 36(2): 108-110.

18391. Betterton, Christine (Dept. of Zool. and Comp. Physiol., Queen Mary College, Mile End Road, London E1 4NS, United Kingdom). 1974. STUDIES ON THE HOST SPECIFICITY OF THE EYEFLUKE, Diplostomum spathaceum, IN BROWN AND RAINBOW TROUT. Parasitology, 69(1): 11-29.

Trout collected from the Hanningfield Trout Farm in Essex, England, were found to be infected with Diplostomum spathaceum. Yearling rainbow trout were blinded with heavy infections of eye fluke, whereas brown trout of the same age carried one-tenth the number of flukes and were clear eyed. Both species were reared under identical conditions, in parallel rearing channels which received water from a common source. Samples showed that young fish exhibited a similar differential in their infestations, and that rainbow trout did not appear to be age-resistant. Laboratory infections produced by exposure of fish to suspensions of cercariae and injection of cercariae into the body cavity reflected the field results, indicating that ecological factors were not involved. Recovery of cercariae from host tissues, and histological observations of similar numbers entering both hosts, indicated that cercariae were able to survive penetration. Excised eye preparations were equally susceptible to infection. Two cm fry of both species were shown to be highly susceptible. Migration in brown trout took 3 h longer than in rainbow trout of the same size, many cercariae being found in the heart during this time. Two mechanisms of insusceptibility were suggested: (1) a greater impenetrability of brown trout tissues; (2) a disorientation of migrating cercariae in brown trout. (Auth.)

18392. Stasko, A. B., and S. A. Rommel, Jr. (Dept. of the Environ., Fish. and Mar. Serv., Biol. Sta., St. Andrews, New Brunswick, Canada). 1974. SWIMMING DEPTH OF ADULT AMERICAN EELS (Anguilla rostrata) IN A SALTWATER BAY AS DETERMINED BY ULTRASONIC TRACKING. J. Fish. Res. Board Can., 31(6): 1148-1150.

Pressure-sensing ultrasonic transmitters in the gut were used to determine the swimming depth of five American eels (Anguilla rostrata) in Passamaquoddy Bay, New Brunswick, in autumn. The eels made frequent dives from surface to bottom, in places diving at least 45 m deep, at vertical speeds to 76 cm/s. About one quarter of the time was spent near the surface; very little time was spent near the bottom or at any constant intermediate depth range. (Authors)

18393. De Sylva, Donald P., and Shoji Ueyanagi (School of Marine and Atmospheric Sci., Univ. of Miami, Miami, Florida 33149). 1974. COMPARATIVE DEVELOPMENT OF ATLANTIC AND MEDITERRANEAN BILLFISHES (ISTIOPHORIDAE). NOAA Tech. Report NMFS SSRF-675, p. 79. (Abstract only).

Developmental stages from about 5 mm to the adult stage are described, illustrated, and compared for the following species: Atlantic sailfish, Istiophorus platypterus; white marlin, Tetrapturus albidus; Mediterranean spearfish, Tetrapturus belone; longbill spearfish, Tetrapturus pfluegeri; and Atlantic blue marlin, Makaira nigricans. Most descriptions are based on material from the western North Atlantic Ocean including the DANA collections from the Sargasso Sea. The status of two other billfish - Tetrapturus georgei from the eastern Atlantic and the so-called "hatchet marlin" of the western Atlantic - is discussed briefly in reference to the identity of an unidentifiable juvenile from the Mediterranean Sea. (Authors)

18394. Gardella, E. S., and A. B. Stasko (Lab. of Limnol., Univ. of Wisconsin, Madison, Wisconsin 53706). 1974. A LINEAR-ARRAY HYDROPHONE FOR DETERMINING SWIMMING DEPTH OF FISH FITTED WITH ULTRASONIC TRANSMITTERS. Trans. Amer. Fish. Soc., 103(3): 635-637.

A hydrophone is described for determining the swimming depth of fish fitted with location-only ultrasonic transmitters. The linear array of 13 transducer elements gives omnidirectional sensitivity horizontally and a two-degree angle of acceptance vertically. The hydrophone is lowered through the water and depth of maximum horizontal signal from a transmitter is determined. Fifty-four trials in a stratified lake, with signal source at distances from 10 to 100 m and at depths from 0.5 to 20.5 m, gave a mean error of -0.46 m (standard deviation = 1.47 m). (Authors)

18395. De Silva, S. S., and F. Balbontin (The Dunstaffnage Mar. Res. Lab., P. O. Box 3, Oban, Argyll, Scotland). 1974. LABORATORY STUDIES ON FOOD INTAKE, GROWTH AND FOOD CONVERSION OF YOUNG HERRING, Clupea harengus (L.). J. Fish Biol., 6(5): 645-658.

Food intake, growth and food conversion of young, 0-group herring were studied at two temperatures and feeding regimes over a period of 19 weeks. The food intake of fish fed to satiation twice daily showed considerable variation. Food intake per fish at 14.5°C was about three times that at 6.5°C, and was generally much higher than in most other species of fish studied. The mean increase in wet weight over the 19-week period was 0.581 g/week at 14.5°C and 0.236 g/week at 6.5°C in fish fed to satiation and 0.094 g/week at 6.2°C and a ration of 1.3% of the body weight. Growth depensation was found to occur even in fish fed to satiation. The changes in specific growth rate, that is the percentage increase in weight/day, showed similar trends at different temperatures and food regimes. The mean conversion efficiency of fish on a ration of 1.3% at 6.2°C was higher than that of fish fed until satiation, at 14.5 and 6.5°C. The conversion efficiency of fish fed to satiation at 14.5°C showed a distinct decrease with increasing weight while at 6.5°C such a clear trend was not observed. In general, the conversion efficiency of young herring were found to be much lower than that of most other species studied. The weight exponent of the quantitative relationship between food intake and body weight at 14.5°C was 0.744. The total metabolic expenditure at 14.5°C, calculated using Winberg's (1956)'utilization coefficient', gave a weight exponent of 0.773. (Authors)

18396. Jolley, John W., Jr. (Fla. Dept. of Nat. Res. Mar. Res. Lab., 100 Eighth Ave. SE, St. Petersburg, Florida 33701). 1974. ON THE BIOLOGY OF FLORIDA EAST COAST ATLANTIC SAILFISH, (Istiophorus platypterus). NOAA Tech. Report NMFS SSRF-675, pp. 81-88.

The sailfish, Istiophorus platypterus, is one of the most important species in southeast Florida's marine sport fishery. Recently, the concern of Palm Beach anglers about apparent declines in numbers of sailfish caught annually prompted the Florida Department of Natural Resources Marine Research Laboratory to investigate the biological status of Florida's east coast sailfish populations. Fresh specimens from local sport catches were examined monthly during May 1970 through September 1971. Monthly plankton and "night-light" collections of larval and juvenile stages were also obtained. Attempts are being made to estimate sailfish age using concentric rings in dorsal fin spines. If successful, growth rates will be determined for each sex and age of initial maturity described. Females were found to be consistently larger than males and more numerous during winter. A significant difference in length-weight relationship was also noted between sexes. Fecundity estimates varied from 0.8 to 1.6 million "ripe" ova, indicating that previous estimates (2.5 to 4.7 million ova) were probably high. Larval istiophorids collected from April through October coincided with the prominence of "ripe" females in the sport catch. Microscopic examination of ovarian tissue and inspection of "ripe" ovaries suggest multiple spawning. (Auth.)

18397. Coad, Brian W., and G. Power (Dept. of Biol., Univ. of Waterloo, Waterloo, Ontario, Canada). 1974. MERISTIC VARIATION IN THE THREESPINE STICKLEBACK, Gasterosteus aculeatus, IN THE MATAMEK RIVER SYSTEM, QUEBEC. J. Fish. Res. Board Can., 31(6): 1155-1157.

Samples of threespine sticklebacks, Gasterosteus aculeatus, from two lakes and a river in the Matamek River system, Quebec were analyzed for five meristic characters. Mean vertebral number differed for each area (range 32.00-32.85) but mean soft fin ray number showed little variation (dorsal rays 11.52-11.79, anal rays 8.68-8.76). Gill raker number was higher in the lake samples (21.25 and 21.80) than in the river sample (20.76). In Matamek Lake only semiarmatus plate morphs were found; in Bill Lake, semiarmatus and trachurus morphs in a ratio of 4:1 with about 10% intermediate; and in the lower Matamek River, semiarmatus and, at a low frequency, leiurus morphs. (Authors)

18398. Mather, Charles O. (Los Angeles City College, Los Angeles, California 90029). 1974. SCIENTIFIC BILLFISH INVESTIGATION: PRESENT AND FUTURE AUSTRALIA, NEW ZEALAND, AFRICA. NOAA Tech. Report NMFS SSRF-675, pp. 102. (Abstract only).

I. Scientists, anglers, skippers, and mates investigate and apply the scientific method. The importance of knowledge, organization, and skills required of the scientist, angler, skipper, and mate in order to bring about a better understanding of the billfish and better methods of catching billfish is discussed. II. The need for more observations and recording of data. The following data should be given important consideration: temperature, depth, time, winds, currents, strike-catch ratio, bait, and the ship's log; these topics are reviewed. III. Scientific research projects for consideration in the future. Potential research projects in Australia, New Zealand, and Africa are presented. Some projects worthy of consideration include: (1) breeding of black marlin at the Great Barrier Reef, Australia; (2) transplanting of small black marlin to a natural salt water lake for study and observation of growth and development (Australia); (3) migration studies by tracking (Australia, New Zealand, Africa); (4) general blood cell surveys (New Zealand); (5) general chromosome surveys (New Zealand); and (6) sensory and motor responses of billfish in relation to sight, smell, and pain (Africa). (Auth.)

18399. Ellis, James E. (U.S. Fish and Wildl. Serv., Fish Farming Development Center, P. O. Box 711, Rohwer, Arkansas 71666). 1974. THE JUMPING ABILITY AND BEHAVIOR OF GREEN SUNFISH (Lepomis cyanellus) AT THE OUTFLOW OF A 1.6-HA POND. Trans. Amer. Fish. Soc., 103(3): 620-623.

Effects of a plunging water flow on the behavior of green sunfish (Lepomis cyanellus) 7.1 to 9.7 cm in total length were studied at the outflow of a 1.6 ha pond. Jumping ability and behavior were measured at 12-hr intervals using a fish's position in a 0.9 m²-vertical grid or in the discharge pipe. Activity was influenced by flow rate, time of day, and time of year. Fish jumped up to 10 times their body length and traversed a horizontal distance of 0.6 m. Fish with the greatest mean length jumped the highest. The majority of the fish were captured during the 0600-hr tending period: 79.9% pipe only study and 82.4% pipe and grid combined study. (Auth.)

18400. Plumb, J. A., J. L. Gaines, E. C. Mora, and G. G. Bradley (Dept. of Fish. and Allied Aquacultures, Agric. Exp. Sta., Auburn Univ., Auburn Alabama 36830). 1974. HISTOPATHOLOGY AND ELECTRON MICROSCOPY OF CHANNEL CATFISH VIRUS IN INFECTED CHANNEL CATFISH, Ictalurus punctatus (Rafinesque). J. Fish Biol., 6(5): 661-664.

A histologic and electron microscopic study was made on selected organs from channel catfish Ictalurus punctatus (Rafinesque) fingerlings that were experimentally infected with channel catfish virus (CCV). Histopathology was characterized by necrosis and haemorrhage in kidney and liver, and haemorrhage in the spleen and gastrointestinal tract. Virus replication occurred in nuclei of cells in the kidney, liver and spleen. Intranuclear inclusion bodies consisting of geometric crystalline arrays and lamellar structures were associated with virus replication. (Authors)

18401. Skillman, Robert A., and Marian Y. Y. Yong (Southwest Fish. Center, Honolulu Lab., NMFS, NOAA, Honolulu, Hawaii 96812). 1974. LENGTH-WEIGHT RELATIONSHIPS FOR SIX SPECIES OF BILLFISHES IN THE CENTRAL PACIFIC OCEAN. NOAA Tech. Report NMFS SSRF-675, pp. 126-137.

Weight-length relationships for six species of billfishes in the central Pacific Ocean were developed by analyzing 20 yr of data. Log-linear and nonlinear statistical models were fitted to the data by regression analysis, and residuals from the models were tested. Blue marlin, Makaira nigricans Lacepede, (50-135 cm FL), maie blue marlin (≥ 135 cm FL) and sailfish, Istiophorus platypterus (Shaw and Nodder), apparently have coefficients of allometry less than 3.0. Black marlin, M. indica (Cuvier) and female blue marlin (≥ 135 cm FL) apparently have coefficients equal to 3.0. Shortbill spearfish, Tetrapturus angustirostris Tanaka, striped marlin, T. audax (Philippi), and swordfish, Xiphias gladius Linnaeus, apparently have coefficients greater than 3.0. (Authors)

18402. Hine, P. M., and C. R. Kennedy (Dept. of Biol. Sciences, The University, Exeter, England). 1974. THE POPULATION BIOLOGY OF THE ACANTHOCEPHALAN Pomphorhynchus laevis (Müller) IN THE RIVER AVON. J. Fish Biol., 6(5): 665-679.

Regular samples of Gammarus pulex and dace Leuciscus leuciscus and occasional grayling Thymallus thymallus and chub L. cephalus were examined from the River Avon, Hampshire, for the presence of the acanthocephalan Pomphorhynchus laevis. The parasite only occurred in medium sized Gammarus due to lower probability of contact with small gammarids and stunted growth and selective mortality amongst older infected ones. No cycles in incidence or development of the parasite in G. pulex were observed. The parasite infected gammarids and grew in all months, and cystacanths were available throughout the year. Despite seasonal feeding activity and dietary preferences, fish fed on Gammarus and acquired infections in all months. Dispersion of P. laevis within the fish population was related to host feeding behaviour. No evidence of seasonal cycles in incidence or intensity of infection in fish was found, and observed monthly changes in the parasite population were related to changes in size structure of the host sample. In dace and grayling P. laevis grew little and matured only in summer, but in chub it grew and produced acanthors all year. The parasite population in fish appeared to be in a state of dynamic equilibrium and gain and loss of parasites took place throughout the year with the level of infection at any moment being determined primarily by the feeding behaviour of the host. This relationship between host diet, water temperature and parasite population size is discussed, and P. laevis in the R. Avon compared with other localities and other parasites. (Authors)

18403. Beckett, James S. (Fish. Res. Board Can., St. Andrews, New Brunswick, Canada). 1974. BIOLOGY OF SWORDFISH, Xiphias gladius L., IN THE NORTH-WEST ATLANTIC OCEAN. NOAA Tech. Report NMFS SSRF-675, pp. 103-106.

The present knowledge of the biology of swordfish in the northwest Atlantic Ocean is summarized. Distribution of swordfish is bounded by 13°C surface isotherms with smaller (under 160 cm) fish in water above 18°C. Males are smaller (under 200 cm) than females and are more frequent in warmer, southern areas. Large fish make feeding excursions to the bottom, to depths of 500 m or more and temperatures 5-10°C. Females attain sizes of 550 kg and males 120 kg, but average size was 54 kg in 1970 commercial landings. Growth is thought to be rapid with weights of 4, 15, 40, 70 and 110 kg attained at annual intervals. Spawning is confined to warmer (over 24°C) southern waters. Tagging data (13 recoveries) suggest fish spend the summer in one locality and return there in subsequent years. High recoveries (18.3%) have been made of fish tagged while swimming free. (Auth.)

18404. Boreman, John (Dept. of Nat. Res., Cornell Univ., Ithaca, New York 14850). 1974. EFFECTS OF STREAM IMPROVEMENT ON JUVENILE RAINBOW TROUT IN CAYUGA INLET, NEW YORK. Trans. Amer. Fish. Soc., 103(3): 637-641.

Standing crops of juvenile rainbow trout in seven bank crib and six pool digger areas were compared with those in natural overhanging banks and pools. There was no difference in biomass, average weight, or number of trout between altered and natural areas. Trout comprised a significantly greater percentage of the total fish biomass in bank crib sections than pool digger sections. A low ratio (1.1:1) of number of age 0+ to older juvenile trout reflected selectivity of the older trout for the sample sections, since Cayuga Inlet in general had a much higher ratio (4.2:1). (Auth.)

18405. Bucke, David (Huntingdon Res. Centre, Huntingdon PE18 6ES, England). 1974. VERTEBRAL ABNORMALITIES IN COMMON BREAM Abramis brama (L.). J. Fish Biol., 6(5): 681-682.

Vertebral abnormalities in bream Abramis brama (L.) and lesions of the caudal peduncle are described. (Auth.)

18406. De Sylva, Donald P. (School of Mar. and Atmospheric Sci., Univ. of Miami, Miami, Florida 33149). 1974. LIFE HISTORY OF THE ATLANTIC BLUE MARLIN, Makaira nigricans, WITH SPECIAL REFERENCE TO JAMAICAN WATERS. NOAA Tech. Report NMFS SSRF-675, p. 80. (Abstract only).

Nomenclature and systematics of the Atlantic blue marlin are briefly reviewed. Its seasonal distribution in the Atlantic is analyzed from commercial and sport fish records. The spawning season in the North Atlantic, which occurs from late spring through late fall, is discussed. Larvae and juveniles are not common, but are easily identifiable. Spawning probably occurs far offshore, with the young developing in waters of the high seas. Feeding probably occurs in the deeper strata. Tunas, frigate mackerels, and cephalopods are the main food items. The growth rate has not been determined, but it is suspected that blue marlin exceed 15 years. Females attain a much larger size than the males; this is attributed to differential mortality. The blue marlin probably undergoes reasonably extensive migrations, and may be considered to comprise populations at least in the North Atlantic and South Atlantic Oceans. The sport fishery, which is extensive and expensive, and valuable economically, is thoroughly discussed. The commercial fishery for the species in the Atlantic is incidental to the tuna fisheries, yet there are some indications that the blue marlin is in some danger of being depleted through commercial activities. (Auth.)

18407. Peters, D. S., and D. E. Hoss (NMFS, Atlantic Estuarine Fish. Center, Beaufort, North Carolina 28516). 1974. A RADIOISOTOPIC METHOD OF MEASURING FOOD EVACUATION TIME IN FISH. Trans. Amer. Fish. Soc., 103(3): 626-629.

Pinfish (Lagodon rhomboides) were fed cerium-144 labeled food to determine if movement of the label could be used to estimate food evacuation time. Radioactivity was retained by the fish until their gastrointestinal tracts were empty. Replicate measurements showed that individual fish may have significantly different evacuation rates. Cerium evacuation and serial slaughter methods provided similar estimates of evacuation time; for the same precision fewer fish are needed for the cerium method. From these experiments, it appears that ¹⁴⁴Ce can be used as a tag to measure food evacuation time. (Authors)

18408. Sylvester, J. R., Colin E. Nash, and Craig E. Emberson (Oceanic Inst., Waimanalo, Hawaii 96795). 1974. PRELIMINARY STUDY OF TEMPERATURE TOLERANCE IN JUVENILE HAWAIIAN MULLET (Mugil cephalus). Prog. Fish-Cult., 36(2): 99-100.

18409. Mathews, Stephen B., and Raymond Buckley (Center for Quantitative Sci. in Forestry, Fish., and Wildl. and College of Fish., Univ. of Washington, Seattle, Wash. 98195). 1974. NATURAL MORTALITY RATE IN LAST WINTER OF LIFE OF COHO SALMON (Oncorhynchus kisutch) RESIDENT IN PUGET SOUND. J. Fish. Res. Board Can., 31(6): 1158-1160.

The natural mortality rate during a 3.5-mo period of the last year of life of coho salmon (Oncorhynchus kisutch) resident in Puget Sound was estimated to be 48% of the population at the beginning of this period. This estimate was based on recaptures of 29 fish out of 169, averaging 32 cm in fork length, tagged in January and early February, and 20 out of 61 averaging 41 cm tagged in May and early June, 1970. (Authors)

18410. Cristy, M. (Dept. of Biol., Univ. of Oregon, Eugene, Oregon 97403). 1974. EFFECTS OF PROLACTIN AND THYROXINE ON THE VISUAL PIGMENTS OF TROUT, Salmo gairdneri. Gen. Comp. Endocrinol., 23(1): 58-62.

18411. Rosenthal, H. (Biologische Anstalt Helgoland, Hamburg, West Germany). 1974. SELECTED BIBLIOGRAPHY ON OZONE, ITS BIOLOGICAL EFFECTS AND TECHNICAL APPLICATIONS. Fish. Res. Board Can. Tech. Report No. 456, 150 p. (Manuscript Status).

18412. Avise, John C., and Michael H. Smith (Savannah River Ecol. Lab., Drawer E, Aiken, South Carolina 29801). 1974. BIOCHEMICAL GENETICS OF SUNFISH. II. GENIC SIMILARITY BETWEEN HYBRIDIZING SPECIES. *Am. Nat.*, 108(962): 458-472.

Electrophoretic variation in proteins encoded by 18 genetic loci was examined in 1,099 specimens of 10 species of sunfish (*Lepomis*), a group renowned for its ability to hybridize, both in the laboratory and in nature. Populations belonging to the same species show very little genic differentiation over considerable geographic ranges. Species pairs show major differences in allelic composition at an average of about one-half of their loci, although the range is considerable. Thus despite ability to hybridize to the F_1 , *Lepomis* species have very different gene pools. Close genic similarity is not a necessary corollary of hybridizing propensity. A dendrogram formed by a cluster analysis of genic similarity coefficients corresponds only mildly with previously developed classifications based on morphology. Biochemical species groups in *Lepomis* appear as follows: (1) *L. cyanellus*; (2) *L. macrochirus*, *L. humilis*, *L. gulosus*; (3) *L. marginatus*, *L. negalotis*, *L. microlophus*; and (4) *L. gibbosus*, *L. punctatus*, *L. auritus*. Groups 3 and 4 appear quite similar and could be lumped into one cohort. The rather close genic similarity of *L. gulosus* to *L. macrochirus* is surprising and is supported by morphological evidence. The discrepancy in similarity matrices based on morphology and proteins of *Lepomis* species makes it clear that electrophoretic methods provide additional information relevant to the subgeneric systematics of fish. (Authors' Summ.)

18413. Wares, Paul G., and Gary T. Sakagawa (U. S. Fish and Wildl. Service, Northwest Fish. Program, 495 Tyee Dr., Tumwater, Washington 98502). 1974. SOME MORPHOMETRICS OF BILLFISHES FROM THE EASTERN PACIFIC OCEAN. NOAA Tech. Report NMFS SSRF-675, pp. 107-120.

Length-weight and morphometric data collected over 4 yr (1967-70) from sport fisheries at three eastern Pacific locations are presented for striped marlin (*Tetrapturus audax*), sailfish (*Istiophorus platypterus*), and blue marlin (*Makaira nigricans*). The data were gathered from San Diego, California (U.S.A.), Buena Vista, Baja California Sur (Mexico), and Mazatlan, Sinaloa (Mexico). Regression of eye-fork length and covariance analysis were used to compare maximum body depth, depth at vent, pectoral fin length, dorsal fin height, maxillary length, snout to mandible and snout to posterior orbit lengths between sexes and areas for each species. Regression equations are given for converting fork length and mandible-fork length to eye-fork length. Based on these conversions our Pacific Ocean data on sailfish are compared with the data from the Atlantic Ocean. Length-weight regressions using both eye-fork length and fork length are given for each species by sex. (Authors)

18414. Barnabé, Gilbert. 1973. MORPHOLOGICAL STUDY OF THE BASS *Dicentrarchus labrax* L. OF THE SÈTE REGION. (Etude Morphologique du Loup *Dicentrarchus labrax* L. de la région de Sète). *Rev. Trav. Inst. Pêches marit.*, 37(3): 397-410. In French with English abstract.

Sampling of the population of *Dicentrarchus labrax* has been done with spear diving catches. Morphometric and meristic data have been used for biometrics index calculation. This index showed that all the bass of Sète area belong to the species *Dicentrarchus labrax* even if they were black spotted on the upper part of the body. Morphology was slightly different according to sex, but sex determination was not always possible using morphometric data. This inshore population presents some morphological characteristics (branchiospine and lateral line scale number) different from the data collected on the same species along the Maroc Atlantic coast by Gravier, 1961. (Auth.)

18415. Mullen, Robert S., Robert S. Shippen, and Kent Mountford (Acad. of Nat. Sciences of Philadelphia, Benedict Estuarine Lab., Benedict, Maryland 20612). 1974. MODULARIZED SYSTEMS FOR FIELD ANALYSIS OF PRIMARY PRODUCTION IN CHESAPEAKE BAY. *Prog. Fish-Cult.*, 36(2): 119-120.

18416. Barbour, Clyde D., and James H. Brown (Dept. of Biol., Univ. of Utah, Salt Lake City, Utah 84112). 1974. FISH SPECIES DIVERSITY IN LAKES. *Am. Nat.*, 108(962): 473-489.

Stepwise multiple regression was used to obtain preliminary insights into the environmental parameters which influence the number of fish species occurring in lakes. For a sample of 70 lakes and inland seas from throughout the world, surface area and latitude account for about one-third of the variability in fish species diversity. For a subsample of 14 North American lakes, latitude and surface area account for about 90% of the variability in species numbers. The large effect of latitude can be explained in terms of climatic severity and isolation from sources of colonization. For a subsample of 14 African lakes, surface area, depth, and conductivity were primary variables affecting species diversity. For 70 lakes of the world and 14 North American lakes, the slope of the species-area curve was low ($Z = 0.15-0.16$). Apparently this reflects the fact that, whereas a relatively large number of species are available to colonize small lakes, larger ones are impoverished. Most of the latter are recent enough that there has not been time for endemic speciation to reach an equilibrium with extinction. We expect the large lakes of tropical Africa to be the closest to such an equilibrium, and it is encouraging that the slope of the species-area curve for the sample including these bodies of water is quite steep ($Z = 0.35$). On the basis of our data and analyses of species distribution in other insular habitats, four patterns of species diversity are distinguished. (Authors' summ.)

18417. Myers, G. L., and J. J. Peterka (Dept. of Zool., Stevens Hall, North Dakota State Univ., Fargo, No. Dakota 58102). 1974. A SYRINGE VOLUMETRIC MEASURING DEVICE. *J. Fish. Res. Board Can.*, 31(6): 1160-1161.

A volumetric measuring device, constructed from a hypodermic syringe and the graduated cylinder of a burette, were described. Steel spheres were measured more accurately and precisely with the device than with graduated cylinders. For spheres of three sizes, the percent deviations of the means of measured volumes ranged from 0.3 to 0.8% in comparison with 0.6-13.1% for graduated cylinders and the standard errors of the means, from 0.007 to 0.011 ml in comparison with 0.029-0.070 ml. (Authors)

18418. Scott, W. B., and S. N. Tibbo (Royal Ontario Museum, Toronto, Ontario, Canada). 1974. FOOD AND FEEDING HABITS OF SWORDFISH, *Xiphias gladius* Linnaeus, IN THE NORTHWEST ATLANTIC OCEAN. NOAA Tech. Report NMFS SSRF-675, pp. 138-141.

Food and feeding habits of swordfish were studied by examining stomachs of 141 individuals captured from July to October 1971 between the Grand Bank and the southeast part of Georges Bank in the Northwest Atlantic Ocean. A wide variety of fish species made up about 80% of the diet; the remainder was squid. Species and size composition of food fishes depended on the feeding area. Large redfish (*Sebastes marinus*) were the most important food item in the Western Bank and Grand Bank areas, whereas silver hake (*Merluccius bilinearis*) made the greatest contribution in the Georges Bank area. Barracudinas, family Paralepididae, occurred most frequently and constituted about 20 percent of the fish diet for all areas. Sabertoothed fishes, family Evermannellidae, also occurred in samples from all areas. (Authors)

18419. Carlson, Anthony R., Richard E. Siefert, and Lawrence J. Herman (U.S. Environ. Protection Agency, Natl Water Qual. Lab., 6201 Congdon Blvd, Duluth, Minnesota 55804). 1974. EFFECTS OF LOWERED DISSOLVED OXYGEN CONCENTRATIONS ON CHANNEL CATFISH (*Ictalurus punctatus*) EMBRYOS AND LARVAE. *Trans. Amer. Fish. Soc.*, 103(3): 623-626.

Channel catfish embryos and resulting larvae were exposed to several reduced dissolved oxygen concentrations and control concentrations near air saturation at 25 and 28 C (7.8 and 7.3 mg/liter, respectively). At 25 C survival was similar but slightly reduced at 60% and 70% saturation (5.0 and 5.8 mg/liter) and was statistically less ($P = 0.01$) at 30% and 50% saturation (2.4 and 4.2 mg/liter).

No embryos hatched at 20% (1.7 mg/liter) and 25 C. Survival to the end of the test at 28 C was slightly reduced at 50%, 60%, and 70% saturation (3.8, 4.6, and 5.4 mg/liter) and was statistically less ($P = 0.01$) at 30% saturation (2.3 mg/liter). At all reduced oxygen concentrations at 25 and 28 C embryo pigmentation was lighter, duration of hatch was extended, feeding was delayed, and growth was reduced. (Authors)

18420. Uchiyama, James H., and Richard S. Shomura (Southwest Fish. Center, Honolulu Lab., NMFS, NOAA, Honolulu, Hawaii 96812). 1974. MATURATION AND FECUNDITY OF SWORDFISH, Xiphias gladius, FROM HAWAIIAN WATERS. NOAA Tech. Report NMFS SSRF-675, pp. 142-148.

Sixteen swordfish, Xiphias gladius, ovaries ranging in weight from 39 to 20,000 g were examined. Fish size ranged from 47 to 246 kg. Based on the occurrence of ripe ovaries, spawning in Hawaiian waters was estimated to extend from April through July. The developmental stages of ova are described; the most advanced ova examined averaged 1.6 mm in diameter. The distribution of ova diameters within an ovary was found to be heterogeneous. Fecundity was estimated for eight swordfish. Some variability in fecundity was noted; a positive curvilinear relationship of increase in fecundity with increase in fish size was evident. Best estimates suggest that an 80 kg swordfish has 3.0 million ova (early ripe or ripe stages) and a 200 kg swordfish has 6.2 million ova. (Authors)

18421. Godshall, Fredric A., Robert L. Cory, and Dale E. Phinney (Environ. Data Service, NOAA, Washington, D.C. 20235). 1974. MEASUREMENT IN A MARINE ENVIRONMENT USING LOW COST SENSORS OF TEMPERATURE AND DISSOLVED OXYGEN. Chesapeake Science, 15(3): 178-181.

18422. Iversen, Robert T. B., and Richard R. Kelley (Southwest Region, NMFS, NOAA, c/o Southwest Fish. Center, Honolulu Lab., NMFS, Honolulu, Hawaii 96812). 1974. OCCURRENCE, MORPHOLOGY, AND PARASITISM OF GASTRIC ULCERS IN BLUE MARLIN, Makaira nigricans, AND BLACK MARLIN, Makaira indica, FROM HAWAII. NOAA Tech. Report NMFS SSRF-675, pp. 149-153.

Gastric ulcers were found in 10 of 114 blue marlin, Makaira nigricans, and 2 of 3 black marlin, M. indica, examined from 1967 to 1969 at the Hawaiian International Billfish Tournament. Parasitic nematodes were found imbedded in the base of ulcers in one blue marlin and two black marlin. The gross and microscopic morphology of the ulcers is given and possible causes are discussed. The most likely cause is either mechanical injury or parasites, or the effect of both in the same stomach. (Authors)

18423. Robins, C. Richard (Rosenstiel School of Mar. and Atmospheric Science, Univ. of Miami, Miami, Florida 33149). 1974. SUMMER CONCENTRATION OF WHITE MARLIN, Tetrapturus albidus, WEST OF THE STRAIT OF GIBRALTAR. NOAA Tech. Report NMFS SSRF-675, pp. 164-174.

Examination of fish catches landed in August 1961 at various ports in southern Portugal and the adjacent coast of Spain demonstrated that the white marlin, Tetrapturus albidus, concentrated in these waters during this month. The coincident absence of white marlin in landings at Sicily make it likely that the species does not enter the Mediterranean in any numbers at least at this season. August concentrations of white marlin elsewhere in the Atlantic are discussed along with the implications of the coincident timing of them on population structure of the species. Morphometric data are presented on 57 specimens from this eastern Atlantic population to facilitate future comparison with specimens from elsewhere in the range of the species. (Auth.)

18424. Beckett, James S., and H. C. Freeman (Fish. Res. Board Can., Biol. Sta., St. Andrews, New Brunswick, Canada). 1974. MERCURY IN SWORDFISH AND OTHER PELAGIC SPECIES FROM THE WESTERN ATLANTIC OCEAN. NOAA Tech. Report NMFS SSRF-675, pp. 154-159.

Total mercury determinations have been carried out on at least one tissue from each of 210 swordfish, 40 specimens of 15 other pelagic species, and 235

individuals of 12 species taken from swordfish stomachs, Total mercury levels of swordfish white muscle tissue ranged from 0.05 to 4.90 parts per million (ppm) (mean 1.15 ppm) total mercury. Mercury levels were broadly related to fish size with the larger fish having higher levels but the relationship varied with time and area of capture. Males tended to have higher levels than females. The mercury levels of different tissues (red muscle, liver, kidney, heart, brain, gill, vertebral disc, and stomach) are given. The differences in the levels in certain tissues from fish taken in different areas suggest greater physiological activity of mercury in fish from the southern area. The significance of mercury in swordfish prey species is discussed. (Authors)

18425. Shomura, Richard S., and William L. Craig (Tiburon Fish. Lab., NMFS, NOAA, Tiburon, California 94920). 1974. MERCURY IN SEVERAL SPECIES OF BILLFISHES TAKEN OFF HAWAII AND SOUTHERN CALIFORNIA. NOAA Tech. Report NMFS SSRF-675, pp. 160-163.

The results of analyses of the mercury content of 37 blue marlin, Makaira nigricans, 56 striped marlin, Tetrapturus audax, and 3 swordfish, Xiphias gladius, are presented. The levels of total mercury found in white muscle of blue marlin caught in Hawaiian waters ranged from 0.19 ppm to 7.86 ppm; fish specimens ranged in total weight from 96 pounds (43.5 kg) to 906 pounds (410.9 kg). A trend of increasing mercury level with increasing size of fish was noted. The mercury content in the livers of 26 blue marlin specimens examined ranged from 0.13 ppm to 29.55 ppm; there was no apparent trend noted between mercury content in the liver and size of fish. Striped marlin from Hawaii and southern California showed a range of mercury levels in white muscle of 0.09-1.09 ppm for the 14 Hawaii samples examined and 0.03-2.1 ppm for the 42 California samples examined. The range in size of fish was 56-139 pounds (25.4-63.0 kg) and 109-231 pounds (49.4-104.8 kg) for the Hawaii and California samples, respectively. From the wide spread of mercury levels encountered in striped marlin, a trend of mercury level with size of fish could not be easily detected. Livers of nine specimens from the Hawaii catch were analyzed; mercury levels ranged from 0.05 ppm to 1.53 ppm. Three swordfish weighing 6 pounds (2.7 kg), 100 pounds (45.4 kg), and an estimated 500 pounds (226.8 kg) contained mercury levels in white muscle of 0.04, 1.71, and 2.10 ppm respectively. (Authors)

18426. Squire, James L., Jr. (NMFS, Southwest Fish. Center, La Jolla Lab., NOAA, La Jolla, California 92037). 1974. CATCH DISTRIBUTION AND RELATED SEA SURFACE TEMPERATURE FOR STRIPED MARLIN (Tetrapturus audax) CAUGHT OFF SAN DIEGO, CALIFORNIA. NOAA Tech. Report NMFS SSRF-675, pp. 188-193.

Records for 4,535 marlin landed at San Diego, California, and related sea surface temperature data were examined for the period 1963 through 1970 to determine time-space distribution and the relationship of catch and sea surface temperatures. For the period 1963 through 1970 the catch of 4,535 marlin was compared to sea surface temperature conditions relative to increased catches. Catch distribution based on 1963 to 1967 data showed that 76.4% were caught within a 35- by 40-nautical-mile area off San Diego, with the maximum catch being made from mid-August to mid-September. Catch temperatures off southern California calculated for this area from airborne infrared sea surface temperature survey data ranged from 61°F (16.1°C) to 73°F (22.8°C); the mean catch temperature was 67.8°F (19.9°C). Sea surface temperature conditions based on 2-week average temperature charts issued by the National Marine Fisheries Service indicate that an initial warming of water to an average temperature of 68°F (20.0°C) or above is related to an increase in catch. When average temperatures were below 68°F (20.0°C), 931 fish were caught; between 68° (20.0°C) and 70°F (21.1°C) the catch was 1,886 fish; and a further increase to 70°F (21.1°C) or above resulted in a catch of 1,718 fish. Catch data and isotherm charts, 1963 through 1970, indicate that the continuity of the 68°F (20.0°C) and 70°F (21.1°C) isotherms from central Baja California to off southern California is associated with improved fishing. When these isotherms were discontinuous the average catch per biweekly

18427. Mather, Frank J., III, Durbin C. Tabb, John M. Mason, Jr., and H. Lawrence Clark (Woods Hole Oceanographic Inst., Woods Hole, Massachusetts 02543). 1974. RESULTS OF SAILFISH TAGGING IN THE WESTERN NORTH ATLANTIC OCEAN. NOAA Tech. Report NMFS SSRF-675, pp. 194-210.

Migrations of sailfish, Istiophorus platypterus (Shaw and Nodder), in the western North Atlantic Ocean are discussed on the basis of results of three cooperative tagging programs. The Rosenstiel School of Marine and Atmospheric Sciences (formerly Institute of Marine Science, and Marine Laboratory) of the University of Miami marked and released 1,259 sailfish between 1950 and 1958 and nine tags were returned. Members of the Port Aransas (Texas) Rod and Reel Club marked and released 515 sailfish between 1954 and 1962 and obtained three returns. The Cooperative Game Fish Tagging Program of the Woods Hole Oceanographic Institution has marked and released 12,525 sailfish between 1954 and May 1972, with 97 tags being returned. The majority of the returns showed limited movements; most were between localities along the southeast coast of Florida and the Florida Keys. The longer migrations did not follow a distinct pattern, but many of them showed a tendency toward movements between tropical waters (north-east coast of South America, the Lesser Antilles, and the Straits of Florida) in the cold season and temperate waters (the Gulf of Mexico and the United States coast between Jacksonville, Florida and Cape Hatteras, North Carolina) in the warm season. Times at liberty, which ranged from less than 1 day to over 4 yr, with only nine exceeding 18 mo, are generally consistent with earlier findings that the sailfish is a short-lived species. Tag returns give no indication of heavy commercial fishing pressure on the stocks under study. (Authors)

18428. Mather, Frank J., III, John M. Mason, Jr., and H. Lawrence Clark (Woods Hole Oceanographic Inst., Woods Hole, Massachusetts 02543). 1974. MIGRATIONS OF WHITE MARLIN AND BLUE MARLIN IN THE WESTERN NORTH ATLANTIC OCEAN - TAGGING RESULTS SINCE MAY, 1970. NOAA Tech. Report NMFS SSRF-675, pp. 211-225.

Migrations of white marlin, Tetrapturus albidus Poey, and blue marlin, Makaira nigricans Lacépède, in the western North Atlantic Ocean are discussed in terms of tag returns obtained since the completion of data collection for the paper by Mather, Jones, and Beardsley (1972) in May 1970. In the period May 1970 - May 1972, 2,039 white marlin and 216 blue marlin have been released, and 70 tags from the white marlin and 1 from a blue marlin have been returned. The migratory pattern which had been established for the stock of white marlin summering off the middle Atlantic coast of the United States has been further supported by 54 of 60 new returns from fish released in this area. The six others deviated from this pattern geographically or chronologically, or in both respects. The ten remaining returns were from releases south of lat. 33°N. Five of these fitted with previously observed patterns or individual migrations. The other five were local or scattered, but one of them extended the range of recaptures southeastward to lat. 4°N, long. 40°W. As previously, times at liberty have been long, and the record has been increased to 58.7 mo. A new calculation, incorporating much additional data, suggests that the annual mortality rate is between 23% and 36%. The single blue marlin return is the first to show a significant migration - at least 750 nautical miles, from the Bahamas to the Gulf of Mexico - and the dates of release and recapture support the theory of separate populations of blue marlin in the North and South Atlantic. After 30 mo at liberty, this fish weighed twice its estimated weight at release. (Authors)

18429. Squire, James L., Jr. (NOAA, NMFS, Southwest Fish. Center, La Jolla, California 92037). 1974. MIGRATION PATTERNS OF ISTIOPHORIDAE IN THE PACIFIC OCEAN AS DETERMINED BY COOPERATIVE TAGGING PROGRAMS. NOAA Tech. Report NMFS SSRF-675, pp. 226-237.

Since 1954, billfish have been tagged by cooperative marine game fish tagging programs in many of the major sportfishing areas of the Pacific. Major locations of tagging have been off southern California, U.S.A., Baja California Sur and mainland Mexico, Panama, and Australia. Two cooperative marine game fish tagging programs have operated in the Pacific, 1) the Cooperative Marine Game Fish

Tagging Program, sponsored jointly by the Woods Hole Oceanographic Institution and the National Oceanic and Atmospheric Administration, National Marine Fisheries Service, and 2) a cooperative program conducted by the California Department of Fish and Game. During 1954-1971, 15,540 billfish were tagged. Records show 9,849 striped marlin (Tetrapturus audax), 4,821 sailfish (Istiophorus platypterus), 622 black marlin (Makaira indica), and 248 blue marlin (Makaira nigricans) were tagged during this period. Ninety-seven tag recoveries have been made; these include 85 striped marlin, 10 sailfish, and 2 black marlin. Eighty-one percent of these recoveries were by longline fishing vessels, the remainder by marine sport fishermen. The tag recovery rates were 0.88% for striped marlin, 0.32% for black marlin, and 0.24% for sailfish. Four types of tags were used in the two programs. Two types of metal tip dart tags were used by the Woods Hole Oceanographic Institution; metal tipped single- and double-barbed plastic dart tags were used by the National Marine Fisheries Service; and a single-barb plastic dart tag was used by the California Department of Fish and Game. Tag types giving the best recovery rate for striped marlin and sailfish were the plastic single- and double-barbed dart tags. Recovery data for striped marlin tagged in the eastern Pacific show a movement away from the tip of Baja California in a south to southwest direction in late spring and early summer. Some recoveries were made of fish tagged near the tip of Baja California and recaptured northwest of the tip of Baja California, Mexico. The migration pattern to the south and southwest at this time of the year may be related to spawning. Striped marlin tagged off southern California show a migration to the south in late summer and early fall. Recoveries of striped marlin in the eastern Pacific were generally short-term (average of 89 days) and covered short distances, averaging 281 nautical miles. Only three of 85 tagged striped marlin, and one of two tagged black marlin, were recovered 1,000 nautical miles or more from the site of tagging. The few recoveries of tagged black marlin (2) and sailfish (10) did not provide sufficient data to determine migration patterns for these species. (Auth.)

18430. Matsumoto, Walter M., and Thomas K. Kazama (Southwest Fish. Center, NMFS, NOAA, Honolulu, Hawaii 96812). 1974. OCCURRENCE OF YOUNG BILLFISHES IN THE CENTRAL PACIFIC OCEAN. NOAA Tech. Report NMFS SSRF-675, pp. 238-251.

Plankton and other net-caught samples collected on past cruises of the National Marine Fisheries Service, Honolulu Laboratory vessels in Hawaiian and central Pacific equatorial waters were examined for billfish larvae and juveniles. Of the 342 billfish young found in 4,279 net tows, 209 were blue marlin, Makaira nigricans, 82 were shortbill spearfish, Tetrapturus angustirostris, 2 were sailfish, Istiophorus platypterus, 20 were swordfish, Xiphias gladius. Twenty-nine larvae were unidentified owing to excessive damage. A preponderance of the catches was obtained from hauls made at the surface during daylight. In the equatorial central and North Pacific larvae of only three of the six billfish species nominally found in the Pacific were taken. The captures of these larvae (blue marlin, shortbill spearfish, and swordfish) fill the gaps in the known distribution of istiophorids and swordfish, and extend their distribution eastward to the Hawaiian Islands in the North Pacific. The two sailfish larvae were taken in New Hebrides waters in the western South Pacific. The absence of striped marlin, Tetrapturus audax, larvae in Hawaiian waters was significant, since this species comprises nearly 82% of all istiophorids taken on the longline in the Hawaiian fishery. Their absence suggested that the striped marlin in Hawaiian waters probably migrate elsewhere to spawn. If this is true, then the spawning habits of this species differ significantly from those of blue marlin. A similar situation could hold for sailfish also. (Authors)

18431. Markle, Gretchen E. (Fish. Res. Board Can., Biol. Sta., St. Andrews, New Brunswick, Canada). 1974. DISTRIBUTION OF LARVAL SWORDFISH IN THE NORTHWEST ATLANTIC OCEAN. NOAA Tech. Report NMFS SSRF-675, pp. 252-260.

Surface plankton collections, mostly with neuston nets toward at 4-5 knots, during eight cruises (1965-1972) yielded 119 swordfish larvae 6-110 mm total length. Captures were grouped in discrete geographical areas: Virgin Islands,

Guiana current, Northwest Caribbean, Windward Passage, and Florida current. All collections were made in January-April, but comparison with other published data suggests that this may not be the peak spawning period. Descriptions of swordfish larvae are appended. (Auth.)

18432. Nishikawa, Yasuo, and Shoji Ueyanagi (Far Seas Fish. Res. Lab., Shimizu, Japan). 1974. THE DISTRIBUTION OF THE LARVAE OF SWORDFISH, Xiphias gladius, IN THE INDIAN AND PACIFIC OCEANS. NOAA Tech. Report NMFS SSRF-675, pp. 261-264.

The distribution of larval swordfish, Xiphias gladius, was determined on the basis of 325 specimens collected from Japanese research vessels operating in the Indian and Pacific Oceans. These larvae, ranging from 3 to 160 mm in total length, were caught by larva-net tows and by dip netting. The larvae are distributed over virtually the entire tropical and subtropical areas of the Pacific Ocean except for the eastern Pacific east of long. 100°W. The northernmost occurrence was at lat. 31°N, long. 132°E, near Kyushu in the western Pacific, and the southernmost was at lat. 22°38'S, long. 105°24'W in the eastern Pacific. Data were insufficient to delineate the distribution in the Indian Ocean. The surface water temperature in the areas of larval swordfish occurrence ranged from 24.1° to 30.7°C. (Authors)

18433. Yuen, Heeny S. H., Andrew E. Dizon, and James H. Uchiyama (NOAA, NMFS, Southwest Fish. Center, Honolulu Lab., Honolulu, Hawaii 96812). 1974. NOTES ON THE TRACKING OF THE PACIFIC BLUE MARLIN, Makaira nigricans. NOAA Tech. Report NMFS SSRF-675, pp. 265-268.

In July of 1971 and 1972 five Pacific blue marlin, Makaira nigricans, were tagged with temperature sensing, ultrasonic transmitters off the west coast of Hawaii. These were tracked for durations up to 22-1/2 h. The paths of three showed movement in a northerly direction. The other two showed no movement. Average swimming speed ranged from 2.2 km/h to 3.4 km/h for the three fish tracked. Swimming depths differed considerably among the three. (Authors)

18434. Nakamura, Eugene L., and Luis R. Rivas (NOAA, NMFS, Gulf Coastal Fish. Center, Panama City Lab., Panama City, Florida 32401). 1974. AN ANALYSIS OF THE SPORTFISHERY FOR BILLFISHES IN THE NORTHEASTERN GULF OF MEXICO DURING 1971. NOAA Tech. Report NMFS SSRF-675, pp. 269-289.

Data were obtained on the sportfishery for billfishes off South Pass, Louisiana, and off northwest Florida in 1971. These data included: dates and times of raises, hookups, and catches by species; locations of raises; areas fished; baits used; water color; surface conditions; boat characteristics. A total of 99 blue marlin (Makaira nigricans), 284 white marlin (Tetrapturus albidus), and 318 sailfish (Istiophorus platypterus) was caught and recorded during 11,107 hours of fishing in the northeastern Gulf of Mexico. White marlin was most abundant in July and August, while sailfish was most abundant in the latter half of September off northwest Florida. Similar periods of abundance for these two species were not evident off South Pass. Blue marlin did not have an especially abundant period in either area. White marlin and sailfish were more abundant off northwest Florida than off South Pass, whereas the reverse was true for blue marlin. The hours of greatest relative abundance for all species of billfishes combined were between 1000 and 1200 and again between 1300 and 1500 off South Pass. A similar pattern was found off northwest Florida (1000-1100 and 1400-1500). Results indicated that the bluer the water, the greater the relative abundance of each of the three species. Off South Pass more billfishes were raised along lines and rips than in any other surface condition, whereas off northwest Florida, more billfishes were raised in open water than in any other surface condition. Moon phase appeared not to have any significant effect on billfishing. Neither did the length of the fishing boats. However, of the boats in the 40 to 49 ft length category, those with twin screws raised more billfishes than those with single screw. Off northwest Florida, blue marlin preferred mullet (Mugil cephalus) over ballyhoo (Hemiramphus sp.) and bonito (Euthynnus alletteratus) strip as bait; white marlin showed no preference; while sailfish preferred bonito strip. Off South Pass, data on bait preference were insufficient to allow conclusions. (Authors)

18435. Squire, James L., Jr. (Southwest Fish. Center, NMFS, NOAA, La Jolla, California 90237). 1974. ANGLER CATCH RATES OF BILLFISHES IN THE PACIFIC OCEAN. NOAA Tech. Report NMFS SSRF-675, pp. 290-295.

In 1969, 1970, and 1971 marine game fish anglers participating in the Pacific phase of the National Marine Fisheries Service cooperative marine game fish tagging program were asked to complete a postcard form which requested information of the number of days of billfishing the angler engaged in and the catches made. From the 17,876 angler days reported, the catch consisted of 10,234 billfishes. The average for the 3-yr period was 0.57 billfish per angler-day or 1.75 days of fishing per billfish. Analysis of data for the geographical areas in the eastern Pacific and Australia (Queensland) where billfishing is conducted resulted in a wide range of catch per effort for all billfish species combined. Off southern California, U.S.A., the catch was 0.10 fish per angler-day, equaling 10.3 days of fishing per fish. Off Baja California, Mexico, records show 0.82 fish per angler-day equaling 1.22 days fishing per fish, and fishing off Mazatlan yielded 1.21 fish per angler-day and 0.82 days fishing per fish. Off Acapulco, Mexico, the results were 0.95 fish per angler-day and 1.05 days per fish. Fishing off Australia the records show 0.55 fish per angler-day equaling 1.83 days per fish. (Auth.)

18436. Yoshida, Howard O. (NOAA, NMFS, Southwest Fish. Center, Honolulu Lab., Honolulu, Hawaii 96812). 1974. LANDINGS OF BILLFISHES IN THE HAWAIIAN LONGLINE FISHERY. NOAA Tech. Report NMFS SSRF-675, pp. 297-301.

The landings of the Hawaiian longline fishery are dominated by the tunas. During 1964 to 1967, the tunas, by weight, made up an average of 66% of the catch, whereas the marlins and swordfish, Xiphias gladius, comprised about 34%. The catch of billfishes is composed of the striped marlin, Tetrapturus audax, blue marlin, Makaira nigricans, black marlin, M. indica, sailfish, Istiophorus platypterus, shortbill spearfish, T. angustirostris, and swordfish. The annual landings of blue marlin ranged between 47 and 366 metric tons during 1952 to 1970. The annual landings of striped marlin fluctuated between 93 and 228 metric tons during the same period. The blue marlin dominated the catch from 1952 to 1961. Subsequent to 1963, the billfish catches have been dominated by the striped marlin. The monthly landings and the monthly catch rates of blue marlin and striped marlin showed similar trends. The monthly landings of striped marlin, however, showed greater fluctuations than the monthly catch per unit of effort. This was attributed in part to a change in the size composition of striped marlin in the third quarter. (Auth.)

Correction:

Volume 19, Number 2, Abstract 17599. Author and pages should have been cited as: Emery, Lee, and Dale C. Wallace (Dept. of Biol., Eastern Michigan Univ., Ypsilanti, Michigan 48197); Amer. Midl. Nat., 91(1): 242-243.

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- Acta Zoologica, Svenska Bokförlaget, Fack, 10420, Stockholm 8, Sweden
 American Midland Naturalist, University of Notre Dame, Notre Dame, Indiana 46556
 American Naturalist, The, Univ. of Chicago Press, Chicago, Illinois 60637
 American Scientist, Society of the Sigma Xi, 33 Witherspoon St., Princeton, New Jersey 08540
 Animal Behaviour, Animal Behaviour Society, Bailliere, Tindall and Cassell, London, England
 Annales D'Hydrobiologie, Institut National de la Recherche Agronomique, 149, rue de Grenelle, Paris - 7^e, France
 Annales Zoologici Fennici, Societas Biologica Fennica Vanamo, Helsinki, Finland
 Applied Microbiology, American Soc. for Microbiology, 4715 Cordell Ave., Bethesda, Maryland 20014
 Archiv für Fischereiwissenschaft, Westliche Berliner Verlagsgesellschaft, Heenemann KG, Berlin - Wilmersdorf, Germany
 Archiv für Hydrobiologie, E. Schweizerbartsche Verlagsbuchhandlung (Nägele u Obermiller) Johannisstrasse 3A, 7000 Stuttgart 1, West Germany
 Australian Journal of Marine and Freshwater Research, Commonwealth Scientific and Industrial Research Organization, 314 Albert St., East Melbourne C2, Australia
 Behaviour, E. J. Brill, Publishers, Leiden, Holland
 Biological Bulletin, The, Marine Biological Lab., Woods Hole, Massachusetts 02543
 Biological Conservation, Elsevier Publishing Co., Barking, Essex, England
 Biological Reviews, Cambridge Philosophical Soc., 32 E. 57th St., N. Y., N. Y.
 Bulletin of Environmental Contamination and Toxicology, Springer Verlag, New York, Inc., 175 Fifth Ave., New York, N. Y. 10003
 Bulletin of Marine Science, Univ. of Miami Press, Coral Gables, Florida 33134
 Bulletin of the Faculty of Fisheries, Hokkaido Univ., Hakodate, Japan
 Bulletin of the Fisheries Research Board of Canada, 116 Lisgar St., Ottawa 4, Ontario, Canada
 Bulletin of the Japanese Soc. of Scientific Fisheries, Japanese Soc. of Scientific Fisheries, Tokyo, Japan
 California Fish and Game, The Resources Agency of Calif., 987 Jedsmith Drive, Sacramento, California 95819
 Canadian Field Naturalist, The, Ottawa Field-Naturalists Club, Ottawa, Ontario, Canada
 Canadian Journal of Zoology, Natural Resources Council, Ottawa 7, Ont., Canada
 Chesapeake Science, Natural Resources Inst. of the Univ. of Maryland, Chesapeake Biological Laboratory, Solomons, Maryland 20688
 Contributions in Marine Science, Univ. of Texas Marine Science Institute, Port Aransas, Texas 78373
 Copeia, American Soc. of Ichthyologists and Herpetologists, Div. of Reptiles and Amphibians, U. S. National Museum, Washington, D. C.
 Ecological Monographs, Duke Univ. Press, Durham, North Carolina
 Ecology, The Ecological Soc. of America and Duke Univ. Press, Durham, N. C.
 EIFAC Technical Paper, European Inland Fisheries Advisory Comm., Food and Agriculture Organization of the United Nations, Rome, Italy
 Environmental Research, Academic Press, Inc., 111 Fifth Ave., New York, N. Y.
 Environmental Science and Technology, American Chemical Soc., 1155 16th St., NW, Washington, D. C. 20036
 Estuarine and Coastal Marine Science, Academic Press, Inc., 111 Fifth Ave., New York, N. Y. 10003
 Eutrophication, Univ. of Wisconsin Water Resources Center Eutrophication Program, 1324 W. Dayton St., Madison, Wisconsin 53706
 Evolution, The Society for the Study of Evolution, 1041 New Hampshire St., Lawrence, Kansas 66044
 Experientia, Birkhauser Verlag, Basel, Switzerland
 FAO Aquaculture Bulletin, FAO of the United Nations, Rome, Italy

- FAO Circulars, FAO of the United Nations, Rome, Italy
- FAO Fisheries Reports, FAO of the United Nations, Rome, Italy
- FAO Fisheries Technical Papers, FAO of the United Nations, Rome, Italy
- Finnish Fisheries Research, Finnish Game and Fisheries Res. Inst., Fisheries Division, Pitkäsillanrata 1A, 00530 Helsinki 53, Finland
- Fishery Bulletin, U. S. Dept. of Commerce, NOAA, NMFS, Seattle, Wash., 98115
- General and Comparative Endocrinology, Academic Press, New York, N. Y.
- Hydrobiologia, Acta Hydrobiologica Hydrographica et Protistologica, The Hague, Holland
- Hydrobiological Journal, Scripta Technica, Inc., 1511 K St., NW, Washington, D. C. 20005
- Institute of Freshwater Research, Fishery Bd. of Sweden, Drottningholm, Sweden
- Internationale Revue der Gesamten Hydrobiologie, Akademie-Verlag GmbH, 109 Berlin, Leipziger Str., 3-4, West Germany
- Investigations in Fish Control, U. S. Fish and Wildlife Service, Dept. of the Interior, Washington, D. C. 20240
- Iowa State Journal of Research, Graduate College, Iowa State Univ., Ames, Iowa
- Japanese Journal of Ichthyology, Tokyo, Japan
- Journal du Conseil, Le Bureau du Conseil, Copenhagen, Denmark
- Journal of Animal Ecology, The, British Ecological Soc., Blackwell Scientific Publishers, 5 Alfred St., Oxford, England
- Journal of Biological Chemistry, The, American Soc. of Biological Chemists, Inc., 9650 Rockville Pike, Bethesda, Maryland 20014
- Journal of Experimental Biology, The, The Company of Biologists, Ltd., Cambridge Univ. Press, London N.W. 1, England
- Journal of Experimental Marine Biology and Ecology, North Holland Publishing Co., P. O. Box 3489, Amsterdam, Netherlands
- Journal of Experimental Zoology, The, The Wistar Institute of Anatomy and Biology, Wistar Inst. Press, 36th St. at Spruce, Philadelphia, Pa. 19104
- Journal of Fish Biology, Fisheries Soc. of the British Isles, Academic Press, Ltd., Berkeley Square House, Berkeley Square, London, England
- Journal of Ichthyology (Voprosy Ikhtiologii), The American Fisheries Soc., Scripta Technica, Inc., 1000 Vermont Ave., NW, Washington, D. C. 20005
- Journal of Immunology, American Assoc. of Immunologists, Williams & Wilkins Co., Baltimore, Maryland
- Journal of Marine Research, Bingham Oceanographic Lab., Yale Univ., New Haven, Connecticut 06520
- Journal of Parasitology, American Soc. of Parasitologists, Rm. 1711, 333 North Michigan Ave., Chicago, Illinois 60601
- Journal of Protozoology, The, Soc. of Protozoologists, 1041 New Hampshire St., Lawrence, Kansas 66044
- Journal of the Faculty of Fisheries and Animal Husbandry, Hiroshima University, Fukuyama, Japan
- Journal of the Fisheries Research Board of Canada, Dept. of the Environment, 116 Lisgar Street, Ottawa, Canada K1A 0H3
- Journal of the Marine Biological Assoc. of the United Kingdom, Cambridge Univ. Press, London, England
- Journal of the Tokyo University of Fisheries, Tokyo, Japan
- Journal of Virology, American Soc. for Microbiology, 4715 Cordell Ave., Bethesda, Maryland 20014
- Journal of Wildlife Diseases, P. O. Box 886, Ames, Iowa 50010
- Journal of Wildlife Management, Wildlife Soc., 3900 Wisconsin Ave., NW, Suite S-176, Washington, D. C. 20016
- Journal of Zoology, The Zoological Soc. of London, Academic Press, Ltd., Berkeley Square, London, England
- Journal Water Pollution Control Federation, 3900 Wisconsin Ave., Washington, D. C. 20016
- Limnology and Oceanography, The American Soc. of Limnology and Oceanography, Inc., Lawrence, Kansas 66044
- Marine Biology, Springer-Verlag New York, Inc., 175 Fifth Ave., New York, N. Y.
- Marine Fisheries Abstracts, Dept. of Commerce, NOAA, NMFS, Div. of Publications, Bldg. 67, U.S. Naval Air Station, Seattle, Washington 98115

- Memoirs of the Faculty of Fisheries, Kagoshima Univ., Kagoshima, Japan
 Nature, MacMillan, Ltd., 711 National Press Bldg., Washington, D.C. 20004
 Netherlands Journal of Sea Research, Netherlands Inst. for Sea Research,
 1 Horntje, P.O. Box 59, Texel, The Netherlands
 New York Fish and Game Journal, N.Y. Conservation Dept., Albany, New York
 New Zealand Journal of Marine and Freshwater Research, Dept. of Science and
 Industrial Research, Box 8018, Wellington, New Zealand
 NOAA Technical Memorandum NMFS NWFC, U. S. Dept. of Commerce, NOAA,
 NMFS, Seattle, Washington 98115
 NOAA Technical Memorandum NMFS NWFC, U. S. Dept. of Commerce, Seattle,
 Washington 98115
 NOAA Technical Report NMFS CIRC, U. S. Dept. of Commerce, NOAA, NMFS,
 Building 67, Naval Support Activity, Seattle, Washington 98115
 NOAA Technical Report NMFS SSRF, U. S. Dept. of Commerce, NOAA, NMFS,
 Building 67, Naval Support Activity, Seattle, Washington 98115
 Ohio Journal of Science, The, 505 King Ave., Columbus, Ohio 43201
 Oikos, Acta Oecologica Scandinavica, Munksgaard International, Copenhagen, Denmark
 Parasitology, Cambridge Univ. Press, 200 Euston Rd., London NW 1, England
 Pesticide Biochemistry and Physiology, Academic Press, Inc., New York, N.Y.
 Physiological Zoology, Univ. of Chicago Press, Chicago, Illinois
 Proceedings of the Helminthological Soc. of Washington, Allen Press, Inc.,
 1041 New Hampshire St., Lawrence, Kansas 66044
 Proceedings of the Royal Society of London B, Royal Soc., 6 Carlton House Terrace,
 London SW 1, England
 Proceedings of the Southeastern Association of Game and Fish Commissioners,
 P. O. Box 167, Columbia, South Carolina
 Progressive Fish Culturist, The, U.S. Fish and Wildlife Service, Washington, D.C.
 Research Reports of the Fish Commission of Oregon, 307 State Office Bldg.,
 Portland, Oregon 97201
 Resource Publications, U.S. Fish and Wildlife Service, Washington, D. C. 20240
 Revue Canadienne de Biologie, Les Presses de l'Universite de Montreal, Montreal,
 Canada
 Rivista Italiana di Piscicoltura e Ittiopatologia, Via Indipendenza, 31100 Treviso,
 Italy
 Roczniki Nauk Rolniczych, Series H, Komitet Nauk Zootechnicznych, Polskiej
 Akademii Nauk, Panstwowe Wydawnictwo Naukowe, Warsaw, Poland
 Rybnoe Khozyaystvo, Fishery Ministry, V. Krasnosel'skaya 17, Moscow B140, USSR
 Science, Amer. Assoc. for the Advancement of Science, 1515 Massachusetts
 Avenue, N.W., Washington, D. C. 20005
 Selected Water Resources Abstracts, U.S. Dept. of Commerce, National Tech-
 nical Information Service, Springfield, Virginia 22151
 Southwestern Naturalist, The, Southwestern Assn. of Naturalists, Austin, Texas
 Suomen Kalatalous, Finnish Game and Fisheries Research Inst., Fisheries
 Division, Pitkansillanrata 1A, 00530 Helsinki 53, Finland
 Systematic Zoology, Allen Press, Inc., 1041 New Hampshire St., Lawrence, Kansas
 Technical Papers, U.S. Fish & Wildlife Service, Washington, D.C. 20240
 Tiedonantoja, Finnish Game and Fisheries Research Institute, Fisheries Division,
 Pitkansillanrata 1A, 00530 Helsinki 53, Finland
 Toxicology, Elsevier, North Holland, Amsterdam, The Netherlands
 Toxicology and Applied Pharmacology, Academic Press, Inc., 111 Fifth Ave.,
 New York, N.Y. 10003
 Transactions of the American Fisheries Society, Allen Press, Inc., Lawrence,
 Kansas 66044
 Transactions of the American Microscopical Society, Allen Press, Inc., Lawrence,
 Kansas 66044
 Tulane Studies in Zoology and Botany, New Orleans, Louisiana
 Water Research, Pergamon Press, Ltd., Fairview Park, Elmsford, N. Y. 10523
 Water Resources Research, American Geophysical Union, 1145 19th St., NW,
 Washington, D. C. 20036

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